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For a printed copy of this manual, contact:

Department of Ecology Environmental Laboratory Accreditation Program

Address: PO Box 488, Manchester WA 98353-0488
E-mail: cosc461@ecy.wa.gov
Phone: (360) 895-6145
Fax: (360) 895-6180

or

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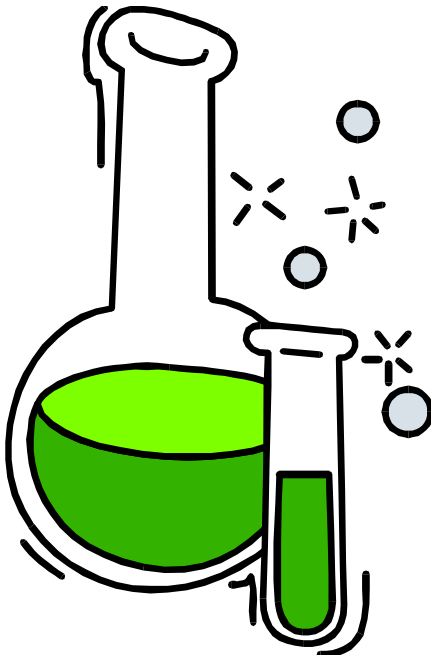

Procedural Manual for the Environmental Laboratory Accreditation Program

by
Lab Accreditation Staff

Lab Accreditation Section
Environmental Laboratory Accreditation Program
Environmental Assessments Program
Washington State Department of Ecology
Manchester, Washington 98353-0488

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Abstract

This manual explains procedures for implementing the Environmental Laboratory Accreditation Program, administered by the Washington State Department of Ecology. The manual provides guidance to laboratories participating in the program and to users of data from these laboratories.

Chapter 173-50 WAC, *Accreditation of Environmental Laboratories,* establishes the state program for accreditation of environmental laboratories, including labs that analyze drinking water. The WAC was last revised in 1993. Since then, the fee schedule established by the rule has lost ground to inflation, preventing the program from being revenue neutral as intended by the Washington State Legislature. Other events also indicated a need to revise the WAC, such as:

- Establishment of the National Environmental Laboratory Accreditation Program (NELAP).
- Transfer of the drinking-water laboratory accreditation mission from the state Department of Health to the state Department of Ecology.
- Promulgation of state rules requiring use of accredited labs to analyze matrices in addition to water.
- Emergence of a new technology, immunoassay, which is expected to find use in future environmental studies.

A revised WAC 173-50 addressing the above issues became effective on November 1, 2002. This version of the *Procedural Manual for the Environmental Laboratory Accreditation Program* recognizes those revisions.

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Introduction

RCW 43.21A.230 establishes program;
RCW 43.20.020 is satisfied.

This manual explains procedures for implementing the Washington State Department of Ecology (Ecology) Environmental Laboratory Accreditation Program which was established under provisions of RCW 43.21A.230 and which satisfies the intent of RCW 43.20.020.

Chapter 173-50 WAC, *Accreditation of Environmental Laboratories,* establishes the state program for accreditation of environmental laboratories, including labs that analyze drinking water. These rules provide the legal basis for the program.

Procedural Manual not used for enforcement.

This manual is provided as an aid to labs affected by the Laboratory Accreditation Program and to users of data from those labs. The manual is not intended for enforcement purposes.

All enforcement actions are based on rules in WAC 173-50 or on rules requiring the use of accredited laboratories. WAC 173-50 does not require labs to be accredited. This requirement is in other state, federal, or regulatory agency rules. Other documents such as permits, grants, or contracts also may stipulate that analytical data come from accredited labs. Policies for use of accredited labs are summarized in Appendix B.

The Laboratory Accreditation Program is an important component of the effort to ensure the accuracy and defensibility of analytical data used by Ecology, the Washington State Department of Health, and other data users. The process described in this manual ensures that accredited labs have the prerequisites and demonstrated capability to provide accurate, defensible data for the parameters specified in the Scope of Accreditation accompanying every accredited lab's certificate.

Meaning of "Accreditation"

Accreditation means:

- The lab's quality system, staff, facilities and equipment, test methods, records, and reports have been evaluated.
- The evaluation indicates the lab has the capability to provide accurate, defensible data.

Accreditation does *not* mean that any specific report or set of data originating in an accredited lab is accurate or defensible. To ensure data quality, data users must require supporting labs to provide sufficient evidence, usually in the form of results of quality control tests, with each set of data.

Contents of Procedural Manual

This procedural manual describes:

For environmental laboratories

- Procedures for applying for participation in Ecology's Laboratory Accreditation Program.
- Process for developing a quality assurance (QA) program of the type expected in an accredited lab and suggestions for preparing an effective QA manual.
- Requirements for participating in proficiency testing studies.
- Preparation for and conduct of the on-site assessment.
- Special provisions for gaining drinking water and/or National Environmental Laboratory Accreditation Program (NELAP) accreditation.

For the Ecology Lab Accreditation Section

- Criteria for establishing reciprocity agreements with other states having accreditation programs, and for recognizing third-party accreditation.
- Criteria for issuing, denying, suspending, or revoking accreditation.
- Procedures for accrediting out-of-state laboratories.
- Mechanisms for notifying laboratories and data users of accreditation actions.
- Mandatory training requirements for Lab Accreditation Section staff.

For users of environmental data from accredited laboratories

- Guidance on what types of quality control (QC) tests to require from accredited labs.
- Guidance on interpretation of QC test results.

Requirements for Participating in the Laboratory Accreditation Program

Initial Accreditation To become accredited, a lab must:

- Submit a complete application and pay the appropriate fee.
- Submit an acceptable quality assurance manual.
- Successfully analyze required proficiency testing samples.
- Pass an on-site assessment by Ecology or another recognized assessor entity.

Continuing Accreditation To retain accreditation, a participating lab must:

- Submit results of performance testing sample analyses.
- Make required improvements in its quality assurance program.
- Report significant changes in facility, equipment, personnel, or QA/QC procedures.
- Submit a renewal application and pay annual fees.
- Submit to required on-site assessments and implement the required recommendations.

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1. Application for Accreditation and Payment of Fees

How does a lab apply?

A lab obtains an application by contacting the Lab Accreditation Section (see Appendix C) or using the Lab Accreditation web site at http://www.ecy.wa.gov/programs/eap/labs/labs_main.html.

In addition to serving as a formal request for accreditation, the application provides evidence that sufficient personnel, equipment, and facilities are available to conduct the tests for which accreditation is requested. All information submitted in the application is subject to verification by the Lab Accreditation Section during the on-site assessment or through other means. The accreditation fee is determined by the number and complexity of tests for which accreditation is requested, and by the process through which accreditation is granted.

For a large, multi-discipline laboratory, completing an application for initial accreditation can be a daunting exercise, and labs are encouraged to contact the Lab Accreditation Section as often as necessary to complete the job. If there is doubt concerning submission of an initial application even after contacting the Lab Accreditation Section, the lab is encouraged to submit a draft for review prior to submitting the final with payment of fee. For renewal of an existing accreditation, completing the application is greatly simplified by noting only changes.

After receiving an initial application from an out-of-state lab when an on-site assessment will be required, the Lab Accreditation Section will give the lab an addendum estimating travel costs for the on-site assessment. The out-of-state lab must return the signed addendum prior to scheduling of the on-site assessment. After completion of the visit, Ecology will invoice the lab for the actual travel costs.

Completed applications and the associated fee should be sent to the Ecology Cashiering Section (see Appendix C). Payment may be made by check, money order, or purchase order. Out-of-state labs, when requesting recognition of an existing accreditation, are often in a hurry to get their application processed so they can, for example, bid on a Washington project. Processing time can be reduced by sending a copy of the first page of the application and the fee to Ecology's Cashiering Section, while concurrently sending the entire application and associated paperwork to the Lab Accreditation Section in Manchester (see Appendix C). Checks and money orders should not be sent to the Manchester address. Purchase orders may be sent to Manchester.

The following explains parts of the application which are especially complex. This discussion generally does not apply to abbreviated applications sent to small labs (e.g., wastewater treatment plant or water district labs). Such applications are straightforward and require no further explanation.

Section 1 - General Information

Paragraph 5 - A lab may request recognition of third-party accreditation, a reciprocity agreement, and/or recognition of NELAP accreditation for some parameters, and direct accreditation by Ecology for others. Mark the appropriate spaces here, and identify parameters for which third-party, reciprocity, or NELAP recognition is requested in Section 5 (Parameter Listing) by marking the applicable parameters with an asterisk (*) in the Fee X/* column.

Section 3 - Proficiency Testing and Certification

List the Proficiency Testing (PT) studies in which the lab has participated in the past 12-month period. Even though most of the PT sample providers have agreed to send the Lab Accreditation Section a copy of their report if requested by the lab to do so, it is a good idea to send a copy of each study report with the application.

Section 4 - Submission Information

An initial application usually includes the completed application form, payment of fee (or purchase order), a copy of at least one PT study report, and a QA manual. These may all be sent to Ecology's Cashiering Section in Lacey where they will be processed, and all but the fee forwarded to the Lab Accreditation Section in Manchester. If a lab is in a hurry to get accredited, the front page of the application and payment of fee can be mailed to Lacey, and the entire application and accompanying documents, minus the fee, sent to Manchester.

Renewal applications usually include all of the above except the QA manual.

Section 5 - Parameter Listing

Because Ecology's Laboratory Accreditation Program now includes matrices in addition to water, this part of the application has become considerably more complex and lengthy for large, multi-discipline labs. (Small, specialty labs such as those operated by permitted wastewater dischargers receive a simplified application.) There are some basic rules that will help labs in completing Section 5 and computing their fee.

- Labs apply for accreditation within *matrix* groups. These four groups – Non-Potable Water, Drinking Water, Solid and Chemical Materials, and Air and Emissions – were adopted from the National Environmental Laboratory Accreditation Program (NELAP). NELAP uses a fifth matrix, tissue, but in Ecology's program, tissue is considered to be in the Solid and Chemical Materials matrix.

- If a specific method can be used for a given matrix, and the lab desires to be accredited for that method within that matrix, the application must request accreditation within that matrix. An example is accreditation for SW-846 methods. Although SW-846 methods (and similar methods, such as the NWTPH-Gx, -Dx, -VPH, and -EPH) *can be* used to analyze aqueous samples, they also are intended to be used on soil and other solid or chemical material (e.g., oil) matrices. Such methods MUST BE requested under the Solids and Chemical

Materials matrix. Likewise, the 500-series organics methods for drinking water MUST BE requested under the Drinking Water matrix. Appendix F lists a number of analytes/ determinands and methods, and the matrices with which they are associated. The list is not intended to be all inclusive; labs may request accreditation for essentially any analytical method for which a written method is available.

- A lab may request accreditation for as many analytes/determinands using as many recognized methods as it desires. A separate fee is charged for each method for a given analyte/ determinand. This includes multiple fees requested for a single matrix, or different methods requested for two or more matrices.

- A given method may be requested in more than one matrix if regulatory programs allow that method to be used in each of the requested matrices. For example, chlorine can be requested by *Standard Methods* 4500-Cl G in both Non-Potable Water and Drinking Water. The same would apply to individual anions by EPA Method 300.0. Although 300.0 has been approved by EPA only for the drinking water program, its use has been allowed in Washington for wastewater, so accreditation for EPA 300.0 can be requested in both Non-Potable Water and Drinking Water. An important consideration is that *only one fee is charged for a given method, regardless of under how many matrices it appears.* The rationale for this is that Ecology assesses the lab's ability for a given method only once, and therefore only one fee should be charged.

- Two or more methods can be requested for the same parameter, with a fee associated with each. For example, requesting EPA Method 202.1 (flame AA) and EPA Method 200.7 (ICP) for aluminum is a valid request. Requesting EPA 202.1 and Standard Method 3111, which are both flame AA methods for aluminum, also is valid. When a lab requests accreditation for a given parameter (analyte/method) in more than one matrix (for example, pH by EPA Method 150.1 in both Non-Potable Water and Drinking Water), only one fee is paid.

- To indicate that some methods can be used for only one matrix, the areas under other matrices are shaded to indicate accreditation cannot be requested under those matrices. For example, looking at the application under Organics 1 (GC and HPLC) reveals that accreditation for trihalomethanes can be requested only under Drinking Water. Likewise, volatile halocarbons, an analyte group normally associated with the NPDES program, *cannot be* requested under Drinking Water.

- Appendix F of this manual identifies typical analytes for which accreditation is often requested, some of the methods requested for the analytes/determinands, and the matrices typically associated with those pairings. It also identifies many analytes/determinands for which no proficiency testing (PT) sample results are required (see *Proficiency Testing,* Section 3 of this manual*)*. If the lab intends to request accreditation for a parameter that is not listed in Appendix F as not requiring a PT sample, the lab should coordinate directly with the Lab Accreditation Section to determine whether a PT sample test is required or not.

- Because the Department of Health did not accredit (certify) microbiology tests by method number, and Ecology's Laboratory Accreditation Program does accredit by method, there

may be some confusion when choosing parameters for which accreditation should be requested in the Ecology program. Supplemental information for drinking water labs on completing the application can be found at Appendix D. If still in doubt, the applying lab should contact the microbiology assessor identified in Appendix C.

- The first time a multi-discipline lab uses the new application might be a daunting experience, requiring much coordination with the Lab Accreditation Section. Subsequent renewals should be much easier as renewal applications will instruct the applicant to identify changes only.

- Also, calculation of the fee may be challenging the first time the new application is used. Labs can request the Lab Accreditation Section to calculate the fee and advise the lab of the outcome, so the applying lab can make informed decisions on what is included on the application.

2. Quality Assurance Manual

When an initial application is submitted and the fee paid to the Ecology Cashiering Section, a quality assurance (QA) manual (or similar document by another name) must be submitted to the Lab Accreditation Section. The detail and scope of the QA manual should be commensurate with the size and mission of the lab. For example, a multi-discipline commercial lab may have a QA manual consisting of several volumes, while a small wastewater treatment plant lab or health district water lab may have a manual of only a few pages.

Why have a QA manual?

The purpose of the QA manual is to identify policies, organization, objectives, functional activities, and QA and quality control (QC) activities designed to achieve quality goals desired for operation of the lab. The manual is also intended to give confidence to users of the lab's reports by indicating specific methods and procedures by which the lab achieves its quality objectives. The QA manual documents who does what, and why, to ensure the quality of results reported by the lab. Quality assurance is important during sampling and transport of samples to the lab, while samples are being analyzed, and when data are reported. Because this is a lab accreditation program, the emphasis in reviewing the QA manual is on the analysis of samples and reporting of results, but documentation regarding sample management and data management is also addressed.

Who uses the QA Manual?

The QA manual is primarily intended for use by lab personnel to ensure reliability of results, and must be readily available to analysts. Secondarily, it is used by personnel outside the lab to gain insight and confidence in the overall QA measures used by the lab.

Is there a certain format for the QA Manual?

A standard format is not required for QA manuals to meet the requirements of Ecology's Laboratory Accreditation Program. The only requirement is that the manual address the needs of the specific lab in which it is used. An outline of a QA manual is presented on the following pages. While it is not necessary to follow this format, all applicable items in the outline should be addressed. As previously stated, the detail provided should be commensurate with the size of the lab and scope of analyses performed. The Lab Accreditation Section is available to assist labs in preparing and maintaining their QA manuals. A model QA manual for a typical, small wastewater treatment plant lab is available from the Lab Accreditation Section.

EPA has not specified a format for a QA manual, but has specified requirements and content for a QA plan. Some labs have prepared QA program plans and/or QA facility plans according to EPA guidelines. These plans often include standard operating procedures (SOPs), each of which instructs someone how to perform a specific task. A QA plan can fulfill the requirements of a QA manual, as long as it includes information on each of the elements described below.

Is there a suggested outline for the QA Manual?

The following is an outline for a typical QA manual:

1. Title Page and Table of Contents

These are not required for short manuals.

2. Glossary

Because some quality assurance/quality control (QA/QC) terms are not universally accepted, a list of frequently used QA/QC terms is a necessary part of a QA manual. Appendix A is a glossary of terms as used by the Ecology Laboratory Accreditation Program. The *Model QA Manual* available from the Lab Accreditation Section also includes an abbreviated glossary.

3. Organization and Responsibilities

This section identifies (1) managers who establish QA policy, (2) analysts/technicians who implement QA policy, and (3) the QA officer/coordinator if one exists. Larger labs should include an organization chart. If organization and responsibilities are already identified in a QA facility plan or other document, they need not be replicated in the QA manual, but the supplemental document should be submitted for review.

4. Policy for QA/QC

The overall policy and philosophy of the lab with respect to objectives for data quality should be included in the QA manual. Include a description of how data quality objectives are established for samples analyzed by the lab. Both qualitative (e.g., completeness, representativeness, defensibility, accuracy) and quantitative (numerical objectives for precision and lack of bias) objectives should be addressed. Policy for training lab personnel in QA/QC should be stated.

5. Sample Management

This section (1) describes those aspects of sampling which relate to or are the responsibility of the lab, (2) specifies procedures for requesting sample analyses (needed by users of the lab) and receipt, logging, storage, and handling of samples, (3) includes procedures for chain-of-custody (if not in a separate SOP or appendix to the QA manual), and (4) includes criteria for acceptance or rejection of samples submitted to the lab.

For samples collected to fulfill NPDES monitoring requirements or drinking water monitoring, required containers, preservation techniques, and holding times are specified in the Federal Register.

6. Methods

Methods includes all analytical methods used in the lab. References can be made to written methods. Detailed SOPs should be included (as appendices or separately) for all in-house methods or modifications to standard methods. For samples analyzed to meet NPDES monitoring or drinking water monitoring requirements, approved test procedures are given in the Federal Register.

7. Calibration and Quality Control (QC) Procedures

This section includes procedures for calibration, standardization, and QC for each method or technique used in the lab. Guidelines should be given for when and how the following QC samples should be analyzed, and how results from each type of test is to be interpreted:

- Blanks
- Check standards (sometimes called blank spikes, fortified blanks, or laboratory control standards)
- Duplicate samples
- Spiked samples (sometimes called matrix spikes)
- Certified (or standard) reference materials (CRMs/SRMs)

Blanks should be run in every batch of samples for applicable tests. For some tests, like pH, there is no blank, and for other tests, like total suspended solids, it does not make sense to run a blank very often.

In general, *check standards* or *reference materials* (CRMs or SRMs) should be run in each sample set whenever such standards are available. If standards are prepared in the lab, a standards log should be kept showing all starting materials, calculations, and disposition of the final standard.

As a check on within-batch precision, a *duplicate sample* should be run in each batch whenever there is no check standard. When a check standard is available and can be analyzed repeatedly as a check of total precision, it is not necessary to run a duplicate with every batch.

Spiked samples should be run to check interference by the matrix.

If a duplicate and a spiked sample are to be run in the same batch, it is best to duplicate the spiked sample to assure the availability of two results as a check on precision. CRMs and SRMs are useful in checking the entire analytical process including digestion of the sample.

Wastewater treatment plant labs, drinking water monitoring labs, and labs limited to general chemistry tests usually are limited to doing blanks, check standards, and duplicates.

8. Monitoring Performance

SOPs should be written to describe the construction and use of control charts, especially for repeated analyses of check standards. An Excel program that semi-automates the control charting process, including instructions on its use, is available from the Lab Accreditation Section.

9. Data Management

The QA manual must address:

- *Data recording* procedures. How are data recorded – on benchsheets, bound notebooks, directly to computer software?
- *Data reduction.* How are computations done – by analyst, supervisor, computer?
- *Data validation*. How are data checked to make sure they are valid – by peer, supervisor?
- *Data entry.* How are final data entered into the system that will generate the final report?

  For smaller labs, data might be copied directly to the report after validation. Most wastewater treatment plant labs would, for example, transfer data directly from log books or benchsheets to the discharge monitoring report (DMR) after being validated by a supervisor.
- *Data reporting.* How is the final report generated – by analyst, supervisor, clerical staff?

10. Assessments

Assessments specifies how often system assessments and proficiency testing are conducted, and by whom. Other types of assessments, such as management systems and data quality, may also be needed for larger labs. As a minimum, the assessments and proficiency testing required for participation in the Laboratory Accreditation Program should be mentioned in this section.

11. Reports

Reports describes the requirements for, and frequency of, reports on QA/QC to management. For labs to be accredited for drinking water, they must adhere to the report retention requirements found in Appendix H of the EPA *Manual for the Certification of Laboratories Analyzing Drinking Water,* latest edition.

Are there special QA manual requirements for drinking water labs?

Drinking water labs are required to address sampling in their QA manuals, if lab staff are involved in sampling. This portion of the QA manual will be reviewed only for drinking water labs.

3. Proficiency Testing

How many proficiency testing study results are required?

Concurrent with review of the application and QA manual, the Lab Accreditation Section advises the applying lab of the requirements for completion of proficiency testing (PT) studies. PT studies involve analysis of blind samples; true values are not known to the lab. If the lab requests accreditation for an analyte that is not listed in Appendix F, the assumption should be that PT sample results ARE required unless confirmed by the Lab Accreditation Section that none is required. A list of approved providers of PT samples is found at Appendix E.

For initial accreditation, one set of PT study results must be submitted. This must be done before the Lab Accreditation Section will schedule the on-site assessment. The study report(s) can be sent with the application/fee to the Cashiering Section, or they can be sent directly to the Lab Accreditation Section to save time.

- For accreditation in the *Drinking Water* category, the PT studies must be those designated by the PT sample vendors as Water Supply (WS) studies

- For accreditation in the *Non-Potable Water* category, the studies can be designated as WS or Water Pollution (WP) studies. If a vendor does not include all analytes in a WS study that would be of interest to a lab seeking accreditation for Non-Potable Water, the lab might need to supplement the WS study by ordering specific WP analytes.

- For accreditation in the *Solids and Chemical Materials* category, the studies must be designated as *Soils.*

- As an exception to the above, accreditation for *radiochemistry* tests, regardless of matrix, requires participation in approved radiochemistry PT studies, and accreditation in the *Air* category, requires that the PT studies be designated as specifically for air samples.

For continuing accreditation, two sets of PT study results must be analyzed for each applicable parameter each year, except for drinking water microbiology parameters where only one per year is required. Two sets of PT study results each year also are required for non-water matrices, if readily available. Labs accredited for *Solids and Chemical Materials* will have until November 1, 2003 to complete their first soils PT study. If PTs are not readily available, standard reference materials (SRMs) may be required. The Lab Accreditation Section decides the availability status of PTs and SRMs for specific parameters. It is the lab's responsibility to be sure required PT samples are analyzed.

After a lab is accredited, the Lab Accreditation Section reviews PT results as a routine procedure only upon renewal of accreditation. For drinking water labs, drinking water PT study results are reviewed upon receipt in the Lab Accreditation Section. Records are checked to ensure accredited labs have submitted PT results semiannually, but with the exception of drinking water PT studies, the results will not automatically be used to update the lab's Scope of Accreditation

until time for renewal. If the lab requests (by telephone, in writing, or by e-mail) that the Scope be updated prior to renewal (e.g., to reflect accreditation for a parameter that had previously been withheld because of unacceptable PT results), the update will include results of reviewing all PT results available to the Lab Accreditation Section at that time.

In addition to WP and WS studies, what PT studies can be used?

PT studies identified below can be used for satisfying accreditation requirements. When study results are submitted, the entire study report must be submitted and is subject to review by the Lab Accreditation Section. This may result in accreditation decisions made concerning analytes/methods other than those for which the study report was specifically submitted. Allowed studies include:

- Make-up studies from one of the approved PT sample providers – i.e., studies in addition to the semiannual water pollution (WP) or water supply (WS) studies.
- Quarterly QB Studies for labs participating the EPA Contract Laboratory Program.
- Quarterly National Council of the Paper Industry for Air and Stream Improvement studies.
- DMR-QA studies, participation in which is mandatory for all NPDES major dischargers, but only once annually. These are acceptable in partially meeting the PT sample analysis requirement. Comparable WP samples analyzed once annually (during the semester the DMR-QA samples are not analyzed) would complete the requirement.
- Various PT studies administered by other state laboratory accreditation programs, such as the New York State ELAP program (but check with the Lab Accreditation Section to determine if the state program's PT samples are acceptable).
- Studies conducted by commercial vendors that include a significant number of participants, thus allowing development of statistically valid acceptance ranges. See below for identification of recognized commercial vendors; others may be used if approved by the Lab Accreditation Section.

Labs should not wait until contacted by the Lab Accreditation Section, or until they must apply for accreditation, to request they be included in PT sample distribution. Prior planning and action in analyzing PT samples will avoid delays in meeting the performance testing requirement for Ecology's Laboratory Accreditation Program. Furthermore, participation in PT studies is a good idea, even for labs that are not participating in the Laboratory Accreditation Program.

Can WS studies be used for accreditation for non-potable water?

If a lab seeks accreditation for non-potable water methods only, WP study PT samples should be analyzed. If a lab seeks accreditation for drinking water parameters, WS study PT samples must be analyzed. Labs seeking accreditation for both potable and non-potable water methods must analyze WS PT samples for the potable water methods. Either WP or WS PT samples can be analyzed for non-potable water methods. If some methods are used for both matrices, only WS PT samples are required for those methods.

Can a lab analyze one sample using several methods?

A few parameters (e.g., organics, trace metals) require special considerations if they are being analyzed by multiple methods.

- Blinds furnished with a PT set can be analyzed by two or more methods for which accreditation is sought (e.g., volatile organics by both GC and GC/MS, or trace metals by both ICP and ICP-MS, or ICP, ICP-MS, and AA). If a lab requests accreditation for more than one method for the same analytical technique (e.g. volatile organics by GC-MS methods using EPA Methods 524 and 624), only one result per PT study is required. However, another result would be required for the same parameter (analyte group) by another analytical technique (e.g. volatile organics by GC methods EPA 502 and 602). PT providers may accommodate the reporting of results by more than one method for a given parameter. Alternatively, whichever results are not reported to the PT sample providers can be reported to the Lab Accreditation Section *before the sample supplier announces the study results.*
- As an alternative to the practice suggested in the paragraph above, the lab may purchase separate blinds and analyze a separate blind by each technique.

What if a given study does not include all parameters of interest?

If a PT study does not include one or more of the parameters for which the lab has requested or will request accreditation, the Lab Accreditation Section may be contacted for recommendations on other sources. The Lab Accreditation Section may also be contacted if there is a need to obtain PT samples for initial accreditation sooner than is possible under a PT provider's distribution schedule. The Lab Accreditation Section may be able to provide samples for such *out-of-cycle* initial accreditations. The lab may choose its own source for PT samples, but the Lab Accreditation Section must approve the source. The list of parameters in Appendix F of this manual identifies those parameters for which PT samples are not required for accreditation because they are not *readily* available.

What if a lab's parent corporation runs its own PT studies?

PT samples are acceptable only if the source provides blind samples (i.e., true values are not released until the lab has completed the analyses and submitted the results), and only if the samples are part of a study in which a statistically significant number of labs participate. Samples provided by the parent company of the lab submitting the results are not considered blind for the purposes of this program.

Must the PT study report sent to Ecology come from the PT vendor?

When using commercial suppliers of PT samples, the lab should report results to the commercial supplier and arrange with the supplier to have the lab's report, including true values, sent to the Lab Accreditation Section as well as to the lab. If this is not acceptable either to the lab or the commercial supplier, the report can be forwarded to the Lab Accreditation

Section by the lab. Having the commercial vendor supply the true values to the Lab Accreditation Section, and the lab provide analytical results to the Lab Accreditation Section for comparison to the true values, is not acceptable (i.e., the supplier of the samples should score the lab's performance).

PT samples must be analyzed just like routine samples.

Special procedures (i.e., procedures other than those used for routine sample analyses) should not be used when analyzing PT samples. For example, no special calibration should be done, and results should be calculated from a single analysis, not as the mean of replicate analyses. Records for PT sample analyses, including raw data, are examined during on-site assessments.

How are PT study results scored?

The Lab Accreditation Section is the final determining authority concerning acceptability of results of PT sample analyses. PT results are classified into four categories (other studies use similar ratings):

1. *Acceptable*. If results are *acceptable*, they certainly meet requirements for accreditation.

2. *Check for Error.* If results are classified *check for error*, the lab should do just that – check for cause of error and take appropriate corrective action.

3. *Unusable Data. Unusable data* ratings are equivalent to *unacceptable* ratings for the purposes of the Laboratory Accreditation Program. Unusable data ratings are usually the result of a lab reporting "less than" values, a practice which is to be avoided. The PT sample vendor should provide instructions for what to do when concentrations are below a lab's detection limit.

4. *Unacceptable.* If results are *unacceptable*, the lab must investigate causes for failure and take corrective action. If a corrective action report is submitted to the supplier of the PT samples, a copy should be furnished to the Lab Accreditation Section.

How are accreditation decisions made based on PT results scored?

If a lab receives a second *unacceptable* rating for a given parameter or parameters, it should again thoroughly investigate causes for failure and submit a report identifying cause for failure and corrective actions to the Lab Accreditation Section. The lab should consider immediately ordering a make-up sample in hopes of receiving an *acceptable* result before the Lab Accreditation Section has a chance to withdraw accreditation. In making the decision on whether or not to order a make-up sample, the lab should take into account the fact that provisional accreditation does not prevent the lab from reporting data to a regulatory agency, but also that unacceptable results on a following study could result in withdrawal of accreditation.

In considering PT results, accreditation decisions for a given parameter are based on the following:

- If current results are within acceptance limits, accreditation will be granted, assuming criteria other than PT results are met.

- If the majority, but not all, of results for the past year are within acceptance limits, provisional accreditation will usually be granted. For PT samples involving an analyte group, such as volatile halocarbons by EPA Method 601, *acceptable* performance means at least 80% of the analytes in a given study are within acceptance limits. However, accreditation may be withheld for specific analytes if repeated unacceptable results are obtained for those analytes. Provisional status may be upgraded to full accreditation upon receipt of acceptable PT results.

- If the majority of results for the past year are outside acceptance limits (e.g., rated *unacceptable*), accreditation will usually be withdrawn, requiring submission of improved results for accreditation to be restored.

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4. On-Site Assessment

The final requirement in the accreditation process is the on-site assessment that involves a visit to the lab by Ecology's Lab Accreditation Section. Section staff may be augmented by Ecology's Manchester Lab or other neutral staff[1] when special expertise is required. Other Ecology personnel may join Lab Accreditation Section staff when assessing labs at wastewater treatment plants.

There is no on-site assessment by Ecology when one of the following is used as the basis for accreditation:

- Accreditation by the National Environmental Laboratory Accreditation Program (NELAP)
- Accreditation by a recognized third party (such as the Army Corps of Engineers)
- Accreditation by another state with which Ecology has established a reciprocity agreement

The Lab Accreditation Section makes advance arrangements with the lab for the on-site assessment. Routine on-site assessments are scheduled for dates and times that are mutually agreeable with the lab. The lab should be prepared to receive the assessor, or assessment team for larger labs, at the arranged date and time. The assessor team attempts to minimize disruption to the normal working routine in the lab. On-site assessment of a large commercial lab may involve three (and seldom more) assessors over a period of one or two days. Assessment of a small wastewater treatment plant lab may involve only one assessor for a portion of a day.

Emphasis in the assessment is on documentation and other evidence demonstrating the lab is producing accurate and defensible data. Assessors examine documents to verify that all information provided in the application and QA manual is correct. Specifically they verify:

- Personnel training and experience status
- Facility features
- Sample handling procedures
- Quality assurance/quality control procedures
- Analytical procedures
- Data handling procedures

Normally, the analysis of proficiency testing (PT) samples is not done as part of the on-site assessment. However, if analysis of PT samples has been identified as a problem prior to the on-site assessment, the lab may be required to analyze a PT sample during the assessment as part of the corrective action to identify and eliminate the cause(s) of the problem.

Checklists are used by assessors when assessing lab capability for specific procedures or methods of analysis for the first time. They may be used in subsequent assessments at the

[1] To avoid a conflict of interest, support staff from a commercial lab will not be used to augment the Lab Accreditation Section staff when assessing another commercial lab.

discretion of the assessor. These checklists are aids to the assessor in assuring assessments are complete and uniform among labs. These checklists may be sent to the lab prior to the on-site visit, with a request that the lab complete the checklists and return them to the Lab Accreditation Section. If completed prior to the assessment, checklists are reviewed by Section staff and used as a basis for further discussion and clarification as necessary during the assessment. This helps to minimize disruption of lab activities during the on-site visit and saves time for all concerned.

The agenda for a typical on-site assessment is as follows:

1. The assessor[2] conducts an entry briefing with the lab manager to discuss the purpose and schedule for the assessment. If the lab manager chooses, additional lab personnel may attend the briefing. If a dedicated QA coordinator is assigned, he or she should attend the entry briefing.

2. The assessor carries out the assessment accompanied by appropriate lab personnel. The lab manager or any other specific management personnel are not expected to accompany assessor during the visit, but may if they wish. The assessor requires access to all parts of the lab and all staff members having anything to do with the analytical procedures for which accreditation is sought.

3. The assessor reviews lab records which should be provided as requested. Records requested may include those corresponding to:
   - Samples including PT samples (e.g., records pertaining to identification, chain-of-custody, preservation, storage, holding times, tracking).
   - Analyses (e.g., methods, calibration, calculations).
   - Quality control (e.g., blanks, check standards, duplicates, spikes, certified reference materials, control charts).
   - Data management (reduction, validation, reporting, entry, assessment).

   The assessor evaluates the entire process of documentation from the time the samples are received by the lab until the results are reported. Only if lab personnel are responsible for sampling are sampling procedures evaluated.

4. The assessor physically examines lab equipment and facilities to determine if they are adequate to perform the analyses requested in the application.

5. Lab personnel are observed performing analyses and making determinations. They are expected to be able to explain what they are doing and why, as well as answer other pertinent questions.

6. If time permits and the lab so requests prior to the assessment, the assessor may provide a training session on a QA/QC or analytical topic of interest to the lab. This training should be arranged with the Lab Accreditation Section when the on-site assessment is first scheduled.

[2] More than one assessor, or an assessment team, may conduct some on-site assessments.

7. An exit briefing is held with the lab manager and selected staff to discuss the observations and preliminary findings of the assessment. Preliminary recommendations for resolution of problems are discussed as appropriate. For larger labs, a tentative time for the exit briefing is scheduled during the entry briefing to allow maximum flexibility in scheduling attendance by appropriate lab personnel. The scheduled time for the exit briefing is adjusted as necessary as the assessment proceeds.

8. Within 30 calendar days of the assessment, a formal report on the assessment findings is sent to the assessed lab. Problems are identified, and formal recommendations for resolution made. Actions that must be completed before accreditation can be granted are identified. If appropriate, the lab is required to report corrective actions within a reasonable period following receipt of the assessment report (usually 90 days).

9. Under certain circumstances where the Lab Accreditation Section has sufficient evidence of a lab's capability, accreditation may be granted before an on-site assessment is completed (see *Interim Accreditation*, Section 8 of this manual*).*

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5. Critical Elements for Accreditation

Certain laboratory operations are critical elements for consistent generation of accurate and defensible data. These elements are the subject of intense scrutiny throughout the accreditation process. Deficiencies in critical elements can be the basis for denial or revocation of accreditation status. For labs to be accredited for drinking water, they must adhere to the critical elements found in the EPA *Manual for the Certification of Laboratories Analyzing Drinking Water,* latest edition. Some, but not all, of those elements have been included in this manual for the convenience of the lab (e.g., personnel).

Analytical Methods

An analytical method is a set of written instructions completely defining the procedure to be followed by the analyst to obtain the required analytical result. It is essential that the analytical method be available to and used by analysts at the bench level. The lab's capability to accurately and defensibly carry out the written method is the basis for accreditation.

Written methods may be either standard published procedures (such as by EPA, ASTM, or *Standard Methods*) or in-house methods.

- When using *standard methods* in unmodified form, the method must be present in the lab and referenced in the QA manual. If standard methods are modified in any significant way, the modifications must be documented, either as an SOP or in an appendix to the QA manual. The modifications can be recorded in a lab notebook if the modifications were made for analysis of a specific set of samples as opposed to being used for all analyses.

- *In-house methods* are non-standard methods that have been either developed in the lab or adapted from sources other than standardized methods, such as articles appearing in the literature. SOPs also are necessary for these methods, so analysts can follow the instructions and consistently get desired analytical results.

Ecology's Laboratory Accreditation Program does not require any specific methods to be used, but assessors check to determine if certain methods are being used when it is known they are legally required. The Federal Register (40 CFR Part 136) lists test procedures that are approved for monitoring effluents under the NPDES permit system. A list of drinking water methods can be requested from the Lab Accreditation Section or viewed/downloaded at http://www.epa.gov/safewater/methods/compmon.html.

EPA's SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods,* suggests methods to be used for solids and hazardous waste. Accreditation for a given method does not imply that the method has been approved for use in any specific regulatory program.

Reports of analytical results must reference the method used for analyses. For standard methods, the reference must be clearly stated so that the client can find and read the method if necessary.

Modifications to standard methods must be clearly identified and explained in the report. Copies of the SOP or lab notebook detailing the modifications should be made available to the client if requested. When in-house methods have been used, copies of SOPs describing these methods (and any modifications documented in notebooks) should be provided to the client if requested.

Equipment and Supplies

The application and on-site assessment are used to determine if sufficient equipment and supplies are available and functioning properly to perform the methods specified in the application for accreditation. Presence, functionality, and maintenance of those items of equipment and supplies required by specific methods is critical to accreditation decisions. Preventive maintenance requirements must be established and documented for all lab equipment and critical facilities (such as hoods). Accredited labs must report to the Lab Accreditation Section significant changes in equipment status (e.g., loss of a key instrument for an extended period for repair) when they occur.

Quality Assurance

Quality assurance and quality control (QC) are basic concepts in the accreditation process. If the lab documents adequate procedures to assure the quality of reported data, and the on-site assessment confirms these procedures are being implemented, there is a strong basis for accrediting the lab. Because accreditation signifies that the lab has demonstrated the ability to produce accurate and defensible data, it is critical that the lab routinely analyze QC samples. Following are the basic types of QC tests and an explanation of how results of the tests are used by Ecology in making an accreditation decision. See the *Glossary* in Appendix A for a definition of each of the QC tests.

Blanks

A blank should be analyzed in every batch for most analyses. For some analyses (e.g., pH), there is no blank. For a few other tests (e.g., total suspended solids), it is not necessary to run a blank in every batch, because the test may be very *robust* (difficult to corrupt). The blank is usually considered to be a test for contamination, but it can also be used to determine that all aspects of the test have been done properly. In the TSS test, for example, failure to completely dry the filter may lead to a positive blank which was not caused by contamination. Consistent failure of blank analyses can be grounds for a decision to withhold accreditation for a given test.

Standards

There are many types of standards, but the one thing they all have in common is that the true value for the sample is known. One test of such a sample does not reveal much useful information. If the result of a single analysis is exactly the true value, it does not mean that a second analysis would yield the same *good* result. Likewise, a single result that is far from the true value does not mean that future analyses will yield the same *bad* result. However, when a standard is analyzed repeatedly, either in a single batch, or over a period of weeks or months in several batches, the *average* result compared to the true value *is* a good indicator of data quality.

The difference between the average and true value is an indication of *bias***.** And by calculating the *standard deviation* of those repeated analyses, the analyst can get an estimate of total *precision*[3]. Because it can give an indication of both bias and precision, the two components of accuracy, the standard is arguably the most important quality control test in an environmental laboratory. A standard should be run in every batch for every test, where a standard is reasonably available and where it makes sense to do so.

- An example of a test where a standard is available, but not reasonably so, would be fecal coliforms. Only if being accredited for drinking water must fecal coliform standards be analyzed, and that is because the federal drinking water program requires analysis of microbiological standards.
- An example of a test where it might not make sense to analyze a standard in every batch is the TSS test. As mentioned above, the TSS test is very robust, and analysis of an occasional standard is sufficient to monitor bias and precision.
- Excessive *bias* and/or *imprecision* as indicated by the average and standard deviation of repeated analyses of a standard can, and normally would be, grounds for a decision to withhold accreditation for a given test.

Duplicates

Duplicates are run to check the precision of some aspect of the monitoring process. If duplicate samples are taken under essentially identical conditions, they can be used to estimate the *precision of sampling*. The Laboratory Accreditation Program is usually not interested in precision of sampling. If a single sample is split into two aliquots in the lab, and each is tested identically, the duplicate pair can be used to estimate *precision of analysis*. Analyzing a duplicate pair in the lab gives the analyst an estimate of *within-batch imprecision* resulting from small differences between the two analyses. If *total precision* is in control as indicated by the standard deviation of repeated analyses of a standard, and *within-batch precision* is not in control, it could be an indication that the matrix is interfering with the analysis. Because the lab has little influence over the matrix, it would be unlikely that a negative accreditation decision would be made because of the errant duplicate results in such a case.

Matrix Spikes

The only difference between a standard and a matrix spike is that a known amount of analyte is introduced to a clean matrix in the standard, and into a dirty matrix in the matrix spike. If repeated analyses of the standard are in control, but the matrix spike is out-of-control, it is undoubtedly the matrix, and not the analytical process that is causing the problem. Accreditation decisions would normally not be made based on matrix spike results. This does not relieve the lab from attempting to find a process for overcoming the matrix interference (such as using a different method or different extraction technique).

[3] Total precision combines the effects of within-batch and between-batch precision. Within-batch precision can be estimated by analyzing duplicates. Between-batch precision cannot be estimated directly.

Sample Management

Sample management is a key element in quality assurance and must be documented in the QA manual. The lab is responsible for those elements of sample management over which it has direct control. The process that results in evidence that the integrity of samples has been maintained from the time of sampling until the analyses are completed, including sample preservation and storage and a documented chain-of-custody, must be documented in the QA manual or elsewhere.

Data Management

Because a lab's only product is a report, and that report is generated from data that are based on observations made in the lab, it is essential that the data be managed properly. Without an effective data management program, a lab's data (and therefore its reports) are not defensible, either scientifically or legally. The following guidelines will assist labs in ensuring the defensibility of data.

- Documentation pertaining to sample analysis must be maintained in notebooks, and, depending on the nature of the lab, the notebooks should be bound and paginated. Smaller labs, such as those at wastewater treatment plants, may maintain benchsheets in three-ring binders. Commercial labs and drinking water labs, on the other hand, should maintain bound, paginated notebooks). Depending on the scope of the lab mission, separate notebooks may be required for standards preparation, sample log-in, instrument run sequence, instrument maintenance, and sample preparation. Very small labs (e.g., a small wastewater treatment plant) may be able to consolidate all information in one or two notebooks. Additional notebooks may be maintained as the laboratory deems necessary.

- For all recorded data, whether recorded in bound logbooks or on benchsheets, the following criteria apply. Failure to comply with these criteria, because the defensibility of data is at risk, may be grounds for denial or withdrawal of accreditation.

    - All logbooks must be paginated before use. This may be done by hand or with a stamping device, or by purchasing paginated logbooks.

    - A permanent record of all analysts' names, initials, and signatures must be maintained. It may be maintained as a permanent file separate from logbooks, or on a dedicated page in each logbook. Even after an analyst leaves the lab, the record of initial/signature must be maintained for at least as long as the lab is required by regulation to maintain data (e.g., three years for NPDES reporting).

    - All entries, for a given day as a minimum, must be dated and initialed.

    - Entries must be made in indelible ink. Pencils are unacceptable because resulting data would not be legally defensible. (It is wise to remove pencils from labs so as to discourage their use.) Felt tip and "roller-ball" pens are not advisable because of the possibility that entries will be destroyed by water or other solvent damage.

    - All deletions and corrections must be crossed-out with a single line, accompanied with the date and initials of the person making the deletion or correction. No information can

be written over or scratched out other than with a single line. "White-out," correction tapes, and other means of correction are not acceptable.

- All logbooks must have the dates of use clearly documented on the front of the log. When a logbook is completed, the ending date of the old log must be the starting date of the new replacement log to eliminate any gaps in the data record.
- Records of standards preparation must be maintained. All stock standard solutions, intermediate standard solutions, and working standard solutions must be documented. Requirements for the recorded information are:
  - All pertinent compound information – such as all compounds or elements in the solution, vendor and the vendor lot number, purity, concentration (if made from a solution), amount used, and date opened – must be recorded. Equations showing how calculations were made should be included. Results must be checked for accuracy by a peer who initials and dates each section checked. A supervisor or designated QA official must check authenticity of data on a regular basis.
  - All solution information – such as the final volume, solvent used, and final concentration – must be recorded. An expiration date for the standard must be recorded when applicable. Additional items that may be recorded are the lot number and vendor of the solvent. When the last of a stock standard is used, the date should be entered in the standards log.
  - If a standard certificate of analysis is provided by the vendor, it must be maintained as part of the standard's permanent record.
  - The date the solution (working standard) is prepared and the initials of the person preparing the standard must be recorded.
- Records of sample receipt must be maintained for all samples, including PT samples. Requirements for sample information are:
  - Pertinent sample information available to the lab must be recorded in the sample logbook. The lab must record the sampling date, type of sample (i.e., grab or composite), matrix type, and the requested analyses. A lab sample identification number must be assigned to the sample and, if applicable, recorded with the client identification number.
  - The date and time of sample receipt must be recorded with the name or initials of the persons receiving and relinquishing the samples. For samples delivered by common carrier (e.g., UPS, FedEx), a copy of the bill-of-lading (shipping bill) should be maintained by the lab. If a bill-of-lading is not provided by the carrier (as it is not by UPS and other carriers who use an electronic record of delivery), the lab should ask the delivery person to sign a form stating that a given number of sample packages was delivered at a specified time. The temperature of the samples also must be recorded, or a record made that wet ice was still present in the cooler, to provide a defensible record that samples received were within or outside of a required temperature range. The condition of the sample containers (e.g., for commercial labs receiving samples in coolers) must be noted in the sample log.

The requirements of the above paragraph are absolute if the lab is required to observe *chain-of-custody* (COC) requirements, as are labs supporting NPDES requirements. If samples which require COC management are received from a remote location, the presence or lack of intact custody seals must be noted.

LIMS and Electronic Maintenance/Reporting of Data

The following applies to data management issues as they pertain to larger labs making use of automated data processing equipment. Some of the information applies to any lab manipulating or storing data on a personal computer.

- In labs using a Laboratory Information Management System (LIMS), an individual should be given primary responsibility for the system. Additionally, all personnel should be adequately trained to allow each to perform his/her duties using the system.
- Equipment (hardware and software) should include a backup and recovery system to ensure data availability in the event of a system failure.
- Access to the LIMS should be limited to personnel with documented authorization, with each individual being given access only to those parts of the LIMS necessary to accomplish the mission.
- The LIMS must provide for archival of records for at least the period required by the regulatory program under which data were gathered (e.g., three years for NPDES monitoring).
- An SOP should be in place covering:
  - System security to include prevention of *time travel* (entering bogus dates)
  - Data entry, analysis, processing, storage, retrieval, backup, and recovery
  - Interpretation of LIMS error codes, if used, and corresponding corrective actions
  - Procedure for making authorized changes to correct errors in data entry
  - Maintenance of system hardware
  - Electronic reporting of data

Confidential Business Information

If during an on-site assessment, or at any other time during the accreditation process, the assessor or assessment team comes into possession of information claimed by the lab to be *confidential business information (CBI)*, that information must be protected from unauthorized disclosure. *Unauthorized disclosure,* as used here, would be any disclosure that is not directly related to the support of accreditation decisions. Title 40, Code of Federal Regulations, Part 2, Subpart B, defines CBI as information that "is entitled to confidential treatment for reasons of business confidentiality." Only the lab can identify CBI and, when doing so, must mark the document or section of a document such that there is no question concerning whether or not it is claimed to be CBI.

6. Recommended Practices

Some elements of lab operations affect efficiency, safety, and other administrative functions but do not normally adversely affect accuracy of analytical data. Deficiencies in those non-critical areas are brought to the attention of lab management under the heading of recommended practices and, individually, are not the basis for denial of accreditation status. Following is a discussion of recommended practices for labs seeking accreditation.

Personnel

The accreditation process seeks to determine if managerial, supervisory, and analytical personnel have adequate training and experience to allow satisfactory completion of analytical procedures and compilation of reliable, defensible, accurate data. Personnel requirements take into account both the size of the lab and the skill necessary to perform the tests.

Position or job descriptions should be available for each lab employee. The job description is a detailed statement of the requirements of the position and should include the following information as a minimum:

- Title and grade
- Organizational unit and/or location of position
- Detailed description of position duties
- Supervision and guidance received

Recommended training and experience for lab personnel are addressed below. They are provided as an aid to labs in establishing criteria for hiring and training of personnel. There are special personnel requirements for staff at accredited drinking water labs at the end of this section. Accredited labs must report significant changes in personnel status (e.g., loss of a key supervisor) to the Lab Accreditation Section when the changes occur.

Lab Director

There should be either a person in this position or a person available for consultation who meets the requirements as a director described below. This requirement may not be necessary for small labs (e.g., a lab supporting a small wastewater treatment plant).

- Academic Training: Minimum of a bachelor's degree in chemistry or a biology science, or, if bachelor's degree is in a field other than chemistry or a biology science, the individual should have college-level credit hours sufficient to qualify for a minor in chemistry or biology.
- Experience: Minimum of two years experience in an environmental lab.

Supervisors

Minimum recommended requirements for supervisor positions are listed below. If the supervisor is also an instrument operator, the requirements for *Instrument Operators* (below) should also be met.

- Academic Training: Bachelor's degree in science that included the number of credit hours in chemistry or biology courses required for a major in one of those disciplines.
- Experience: Minimum of one year experience in an environmental lab.

Instrument Operators

Personnel operating atomic absorption (AA), ion chromatograph (IC), gas chromatograph (GC), gas chromatograph/mass spectrometer (GC/MS), liquid chromatograph (LC), inductively coupled plasma (ICP-AES), automated (continuous flow) analyzers, or other instruments of comparable complexity should meet the following requirements:

- Academic Training: Bachelor's degree in chemistry or related field. This may not be necessary if the immediate supervisor has a bachelor's degree in chemistry or related field, or if the analyst has the number of credit hours in chemistry courses required for a major in chemistry.
- Specialized Training: Satisfactory completion of a short course offered by the equipment manufacturer, a professional organization, university, or other qualified training facility.
- Experience: Minimum of six months experience in operation of the instrument (see *Trainees* below).
- Initial Qualification: After appropriate training, the analyst should demonstrate the ability to produce acceptable results in the analysis of an applicable quality control or proficiency testing sample.

Other Analysts

Other analysts (e.g., chemistry, biology, or microbiology technicians) should meet the following minimum requirements:

- Academic Training: High school diploma.
- Initial Qualification: After being trained in a methods training course or by a qualified analyst, the trainee should demonstrate acceptable results by analyzing applicable quality control or proficiency testing samples.

Wastewater Treatment Plant Operators

For wastewater treatment plants which do not have full-time analysts and where analyses are performed by plant operators, the operators must meet the requirements of Chapter 173-230 WAC, *Certification of Operators of Wastewater Treatment Plants*. The basic requirement of this

regulation is that the operator in charge of the treatment plant must be certified at a level equal to, or higher than, the classification rating of the treatment plant, and that when a plant is operated by more than one daily shift, the individual in charge of each regular shift must be certified at a level not less than one class lower that the class of the plant.

Drinking Water Lab Staff Requirements

Lab Supervisor. The lab supervisor should have:

- at least a bachelor's degree with a major in chemistry (or microbiology, radiochemistry, microscopy, as applicable for specialty labs) or equivalent,
- at least one year of experience in the analysis of drinking water, and
- at least a working knowledge of quality assurance principles.

Lab Analysts. The lab analysts should have:

- at least a bachelor's degree with a major in chemistry (or microbiology, radiochemistry, microscopy, as applicable for specialty labs) or equivalent,
- at least one year of experience in the analysis of drinking water, and
- specialized training on applicable instrumentation, or one year of apprenticeship for such instrumentation.

Additionally, lab analysts must demonstrate acceptable results for blanks, precision, acceptable bias, ability to meet required method detection limits, and satisfactory analysis of PT samples before assuming independent testing.

Technicians. Lab technicians should have:

- at least a high school diploma or equivalent,
- complete a method training program under an experienced analyst, and
- six months experience in the analysis of drinking water samples.

Sampling Personnel. If lab personnel participate in sample collection, they should be trained in the proper sampling techniques, and their abilities should be checked by experienced sampling or lab personnel.

Trainees

Data produced by analysts and instrument operators while in the process of obtaining training or experience are acceptable when reviewed and validated by a fully qualified analyst or the lab supervisor.

Facilities

The application and on-site assessment are used to determine if lab facilities are sufficient to allow efficient generation of reliable, defensible, accurate data. Lab facilities should be clean, have temperature and humidity adequately controlled in the instrument areas, and have adequate lighting at the bench top. The lab should have provisions for the proper storage and disposal of

chemical wastes. Exhaust hoods with a verified airflow of 75-125 cubic feet per minute (CFM) should be available for preparation, extraction, and analysis where applicable.

For chemistry determinations, a minimum of 150 square feet of lab space and at least 15 linear feet of usable bench space per analyst is recommended. Workbench space should be convenient to sink, water, gas, vacuum, and electrical sources. Electrical sources should be free of surges and unanticipated outages. Inorganic and organic facilities should be separate rooms. Facilities used for analysis of volatile organics should be at an overpressure relative to other lab areas. The analytical and sample storage area should be isolated from all potential sources of contamination. Standards requiring refrigeration (e.g., volatile organics) should be stored separately from samples.

For microbiology determinations, a minimum of 150 square feet of lab space and five linear feet of usable bench space per analyst is recommended. Lab facilities should include sufficient bench-top area for processing samples; storage space for media, glassware, and portable equipment; floor space for stationary equipment (e.g., incubators, water baths, refrigerators); and associated areas for cleaning glassware and sterilizing materials.

For bioassay determinations, facility requirements depend primarily on the type and number of tests to be performed. In general, space requirements are relatively large.

Safety

Generally, safety procedures are not critical elements of the on-site assessment. This does not imply a lack of concern for safety but instead a recognition that other regulatory agencies have primary responsibility over the area. Serious safety deficiencies observed during the on-site assessment are referred to the appropriate state or federal regulatory agencies for follow-up.

All labs should be provided with fire extinguishers. Fume hoods should be available if dangerous fumes are likely to be present during lab operations. Safety glasses should be worn by analysts and readily available for visitors. Eye washes and overhead showers should be readily available if dangerous (e.g., caustic, acidic, otherwise corrosive) materials are used. Lab areas likely to be wet should have ground fault protection for electrical circuits. Material Safety Data Sheets (MSDS) should be readily available for all chemicals used in the lab.

7. Evaluation and Issuance of Certificate

Following completion of the initial on-site assessment, the Lab Accreditation Section prepares a report, addressed only to the affected lab, concerning results of the accreditation process (application, QA manual, proficiency testing, and on-site assessment). The Lab Accreditation Section maintains a copy of the report. The report lists findings, assesses the importance of each finding, and, as appropriate, makes recommendations about resolution of problems.

- If results indicate accreditation of the lab is justified, the Lab Accreditation Section issues a certificate authorizing the lab to submit data to Ecology, Washington State Department of Health (DOH), or another data user, for those parameters included in the accompanying Scope of Accreditation.

- If results indicate the lab should not be accredited (see *Denying or Revoking Accreditation Status,* Section 11 of this manual), the lab is advised of:
  - The reasons and, after allowing a specified period to correct deficiencies, specific areas of deficiency may be re-assessed, or
  - Some other specific action required as a basis for a subsequent accreditation decision.

If the accreditation is for a lab that reports drinking water data, the DOH Drinking Water Program is notified of accreditation actions.

List of Participating Labs

A list of labs participating in Ecology's Laboratory Accreditation Program, indicating their current accreditation status, is maintained by the Lab Accreditation Section and is distributed to interested persons upon request.

A list of accredited labs and a list of accredited drinking water labs are posted on the Lab Accreditation Section web site at http://www.ecy.wa.gov/programs/eap/labs/labs_main.html.

8. Interim and Provisional Accreditation

Interim Accreditation

Ecology's Lab Accreditation Section initially may not be able to complete the accreditation process for an applying lab in a timely manner. For any valid reason based on a limitation within Ecology, and not the lab, an interim accreditation *may* be granted based on review of the application, QA manual, SOPs, and successful completion of proficiency testing where appropriate. The on-site assessment is completed as soon as practical after which a decision on full accreditation would be made.

When the on-site assessment does not include complete evaluation for a specific analyte and method (e.g., because the capability did not exist at the time of the on-site assessment), the lab may be requested to submit to the Lab Accreditation Section a *technical data package* for use in making an accreditation decision. Based on review of the data package and PT sample analysis results, if appropriate, a decision may be made to grant interim accreditation pending completion of the on-site assessment. The content of such data packages will vary depending on the type of data reported but generally will contain, as applicable, complete information on the following:

- *Sample preparation* – including sample collection dates, sample preparation dates, sample identification, sample size, matrix spike compounds and amounts used, surrogate compounds and amount used, and all data pertaining to sample cleanup.
- *Calibration* – all calibration data, including amounts and/or concentrations of external and internal standards used. The data should make clear which calibration curve or factor was used to calculate individual sample results.
- *Sample analysis* – method used, sample analysis dates, final volumes (dilutions, splits, or aliquots), sample raw data (chromatograms, spectra, absorbances, other instrument outputs).
- *Quality control* – method blank data, check standard data (including checks on calibration), duplicate sample analysis data, matrix spike recovery data, and surrogate spike recovery data.
- *Reports* – final report forms (e.g., data summary with reporting limits, blank summary, matrix spike summary, surrogate summary, and QC sample summary).

Provisional Accreditation

A lab having deficiencies indicating an analytical problem, but not a complete inability to provide reliable, accurate, and defensible data, may be given a provisional accreditation pending resolution of those deficiencies. Under some circumstances, the Lab Accreditation Section will specify a date by which deficiencies must be corrected. Upon determining that the deficiencies have been corrected, the Lab Accreditation Section takes action to award full accreditation. If a lab fails to correct the deficiencies within the time period allowed, accreditation may be revoked for the affected parameters (see *Denying or Revoking Accreditation Status*, Section 11 of this manual). There is no equivalent to provisional accreditation for NELAP accredited labs.

9. Accreditation Categories

Ecology's Laboratory Accreditation Program accredits by matrix, analyte, and analytical method. The four matrices for which accreditation can be granted are:

1. Drinking Water
2. Non-Potable Water (all aqueous matrices other than drinking water)
3. Solids and Chemical Materials (solids, semi-solids, and hazardous waste that may include aqueous materials)
4. Air and Emissions

The four matrices above are those for which the National Environmental Laboratory Accreditation Program (NELAP) accredits labs. NELAP accredits for a fifth matrix, tissue, which in Ecology's program is included in the *Solids and Chemical Materials* matrix.

For each matrix, environmental labs are accredited within the broad technology categories. Not all of the following technology categories apply to each of the four matrices.

- Chemistry I (General)
- Chemistry II (Trace Metals)
- Organics I (GC, HPLC Methods)
- Organics II (GC/MS Methods)
- Radioactivity
- Microbiology
- Bioassay/Toxicity
- Immunoassay
- Physical

Within those categories, labs are specifically accredited to perform within well-defined parameters. For example, a given lab may be accredited to analyze purgeable halocarbons using EPA Method 601 and phenols using EPA 604 under *Organics I*, and dioxin using EPA Method 613 under *Organics II*.

Accreditation for some methods can be requested in only one of the matrix groups. For example, all 500-series methods for organics can be requested only in *Drinking Water,* and SW-846 methods can be requested only in *Solids and Chemical Materials,* even though the lab may be using those methods exclusively for testing aqueous samples. An important feature of Ecology's accreditation program is that a specific method can be accredited for more than one matrix (e.g., EPA Method 150.1 can be accredited for both *Drinking Water* and *Non-Potable Water*), but the lab pays only one fee. The same does not hold true for methods that are essentially identical, such as EPA Method 200.7 (ICP in *Water*) and EPA Method 6010 (ICP in *Solids and Chemical Materials*).

10. Requirements for Maintaining Accreditation Status

Accreditation is normally granted for a one-year period and expires one year after the effective date on the certificate. For a cause that must be documented by the Lab Accreditation Section, the accreditation period may be extended for a period not to exceed an additional year, except for NELAP accredited labs. The accreditation period can also be shortened by a few days or weeks if, for example, the lab underpays their fee. The accreditation period is not lengthened or shortened without the consent of the applying lab.

Approximately 60 days before expiration, accredited labs are sent a renewal application. Applications and fees will normally be submitted during the 60-day period prior to the expiration of the current accreditation. Renewal requires submission of an application in which significant changes are noted, submission of appropriate fees, and analysis of required proficiency testing samples.

On-site assessments are normally required every three years to maintain accreditation. For a cause that must be documented by the Lab Accreditation Section, the follow-up on-site assessment period may be extended, but not to exceed four years between assessments. On-site assessments of drinking water labs are not delayed beyond three years. (For purposes of this program, “three years” is considered to be a period of from 34 to 38 months.)

The purpose of the third year on-site assessment is to determine if the lab’s capability has been adequately maintained, and to evaluate any capabilities added since the last assessment. Re-assessments will usually involve a more focused evaluation of selected analytical capabilities, based on review of the lab's performance since the last assessment.

11. Denying or Revoking Accreditation Status

Denying Accreditation

A lab may be denied accreditation if it (WAC 173-50-140):

- Fails to comply with standards for critical elements of the on-site assessment,
- Misrepresents itself to the department (Ecology),
- Fails to disclose pertinent information in the application,
- Falsifies reports of analysis including PT results,
- Engages in unethical or fraudulent practices concerning generation of analytical data,
- Is deficient in its ability to provide accurate and defensible analytical data, or
- Fails to render applicable fees.

Additionally, accreditation may be denied for specific parameters for unsatisfactory analysis of those parameters in the proficiency testing. Since labs are accredited for specific parameters, it is possible to be denied accreditation for some parameters while maintaining accreditation for others. For some tests, accreditation is granted for *analyte group* rather than specific analyte (e.g., volatile halocarbons by EPA Method 601). For such analyte groups, *unsatisfactory analysis* means getting *not acceptable* results on more than 20% of the individual analytes.

Revoking Accreditation

Accreditation status may be suspended or revoked if the lab (WAC 173-50-150):

- Fails to comply with standards for critical elements of an on-site assessment,
- Violates a state rule relative to the analytical procedures for which it is accredited,
- Misrepresents itself to the department (Ecology),
- Falsifies reports of analysis including PT results,
- Engages in unethical or fraudulent practices concerning generation of analytical data,
- Is deficient in its ability to provide accurate and defensible analytical data,
- Refuses to permit entry to the lab for enforcement purposes, or
- Fails to pass an on-site assessment scheduled because there was reason to believe the lab was consistently submitting erroneous data.

Revocation is a permanent status requiring the lab to apply, pay a fee, and go through pertinent steps of the accreditation process including, if necessary, an on-site assessment. *Suspension* is a temporary withdrawal of accreditation for a specific period during which the lab takes corrective action directed toward regaining accreditation. If successful corrective action cannot be taken within the suspension period, accreditation for the applicable parameter(s) may be revoked.

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12. Relationship to other Accreditation and Inspection Programs

Reciprocity

An objective of Ecology's Laboratory Accreditation Program is to negotiate agreements with other state certification or accreditation programs meeting the standards of the Washington State program to allow for reciprocity between the two programs. As the term implies, the agreement would be such that if Washington recognizes the accreditation of labs in another state by their state's accrediting agency, that state would *reciprocate* and recognize accreditation of labs in Washington.

Where both state programs meet the same goals, reciprocity is possible. Out-of-state labs are encouraged to contact their lab accreditation regulatory agency for the purpose of inviting that agency to contact Ecology's Lab Accreditation Section regarding a possible reciprocity agreement.

Generally, a lab applying for recognition of their home state's accreditation can be accredited only for those specific parameters accredited by the home state. There are some exceptions, however, and the lab should contact the Lab Accreditation Section if there is any question. For example, a lab can be accredited by Washington for use of the NWTPH-Gx and –Dx procedures – gas-range and diesel-range organics, respectively – if they are accredited for similar tests by their home state, and if their methods comply with the requirements of the Washington methods.

Out-of-state labs considering applying for recognition of a reciprocity agreement with their home state should contact the Lab Accreditation Section before submitting an application to ascertain whether or not such a reciprocity agreement exists and, if so, how the fee is calculated. Ecology's preferred position on the fee is that there should be a significant discount because Ecology does not have to conduct an on-site assessment. However, some states charge their full fee for recognizing a reciprocity agreement, in which case Washington reciprocates by also charging its full fee.

Labs applying for accreditation through recognition of a reciprocity agreement must provide documented evidence including:

- Their Certificate and Scope of Accreditation issued by their home state
- A copy of the accrediting agency's on-site assessment report
- A copy of the lab's corrective action report
- A copy of the latest PT sample analysis report(s)
- A copy of their QA manual

Semiannual (or annual in the case of microbiology PT studies) PT sample analysis results are used as the primary basis for monitoring lab performance on a continuing basis (i.e., after initial accreditation), just as they are for labs accredited through the normal process.

Recognition of a Third-party Accreditation

Ecology may recognize accreditation (or certification, licensure, approval) of a lab, including in-state and out-of-state labs, by a third party (i.e., private or government organization, independent of the applying lab or Ecology).

An example of a third party which has been recognized by the Washington State Department of Ecology Laboratory Accreditation Program is the *American Association for Laboratory Accreditation (AALA)*, a non-profit, scientific, membership organization that operates a national lab accreditation system.

Labs considering applying for recognition of accreditation by a third party should contact the Lab Accreditation Section before submitting an application to ascertain whether or not the third party is or could be recognized by Ecology.

Labs applying for accreditation through recognition of a third party's accreditation must provide documented evidence including:

- Their Certificate and Scope of Accreditation issued by the third-party accrediting authority
- A copy of the accrediting agency's on-site assessment report
- A copy of the lab's corrective action report
- A copy of the latest PT sample analysis report(s)
- A copy of their QA manual

Semiannual (or annual in the case of microbiology PT studies) PT sample analysis results are used as the primary basis for monitoring lab performance on a continuing basis (i.e., after initial accreditation), just as they are for labs accredited through the normal process.

Recognition of National Environmental Laboratory Accreditation Program (NELAP) Accreditation

Ecology may recognize accreditation by a NELAP accrediting authority (a state or federal agency certified by the National Environmental Laboratory Accreditation Conference (NELAC) as authorized to grant NELAP accreditations).

As of the writing of this manual, there were twelve NELAP accrediting authorities:

- California Environmental Protection Agency
- Florida Department of Health
- Illinois Environmental Protection Agency
- Kansas Department of Health and Environment
- Louisiana Department of Health and Hospitals
- Louisiana Department of Environmental Quality
- New Hampshire Department of Environmental Services
- New Jersey Department of Environmental Protection

- New York Department of Health
- Oregon Health Division
- Pennsylvania Department of Environmental Protection
- Utah Department of Health

For the latest on approved NELAP accrediting authorities and other NELAP information, contact the Lab Accreditation Section or visit NELAP's web page at http://www.epa.gov/ttn/nelac/nelapaa.html

Labs considering applying for recognition of accreditation by a NELAP accrediting authority should contact the Lab Accreditation Section before submitting an application to ascertain whether or not the specific accrediting authority has been recognized by Ecology (as a non-participant in NELAP, Ecology is not required to recognize all NELAP accrediting authorities).

Labs applying for accreditation through recognition of a NELAP accreditation must provide documented evidence including:

- Their Certificate and Scope of Accreditation issued by the NELAP accrediting authority
- A copy of the accrediting agency's on-site assessment report
- A copy of the lab's corrective action report
- A copy of the latest PT sample analysis report(s)
- A copy of their QA manual

Semiannual (or annual in the case of microbiology PT studies) PT sample analysis results are used as the primary basis for monitoring lab performance on a continuing basis (i.e., after initial accreditation), just as they are for labs accredited through the normal process.

Permitted Wastewater Discharger Compliance Inspections

Once a lab operated by a permitted wastewater discharger is accredited, compliance inspections performed by Ecology (Class I and II inspections) no longer include a complete evaluation of lab capabilities. Compliance inspectors may require accredited labs to analyze split samples for comparison to analysis of the same split by Ecology's lab. They may check validity of records, such as the Discharge Monitoring Report, to determine that reported data are representative of analytical results achieved in the lab. They may also inspect sampling procedures, which are not evaluated as part of the lab accreditation process. Usually compliance inspections will not include evaluation of the analytical capability of accredited labs since that is the primary responsibility of the Laboratory Accreditation Program.

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13. Exemptions

Chapter 173-50-180(1) WAC allows wastewater dischargers whose labs meet exemption qualifications to request exemption from accreditation requirements. Those labs must submit a letter from EPA Region 10 verifying that they meet all requirements of EPA Order 5360.1, for an EPA administered quality assurance program.

Generally this order specifies that the following elements are required for a QA program:

- Current QA program/project plans
- Proficiency testing
- On-site assessments
- Corrective action for assessment deficiencies
- Quality control guidelines and records
- Training in QA for lab management personnel

The contact person at EPA Region 10 is the Quality Assurance Officer as indicated in Appendix C in this manual. The following note is extracted from WAC 173-50-180:

Note: The federal Environmental Protection Agency does not presently administer a complete quality assurance program for wastewater dischargers in the state of Washington, such as would provide an exemption under subsection (1) of this section. Thus, this exemption is not presently available. The Environmental Protection Agency considers annual analysis of performance evaluation samples to constitute only one element of participation in a quality assurance program. The complete Environmental Protection Agency Quality Assurance Program is described in their Order 5360.1, "Policy and Program Requirements to Implement the Mandatory Quality Assurance Program," which is the basis for exemption requirements stated in subsection (1) of this section.

14. Appeals

Managers of environmental labs may appeal final accreditation actions (awards, denials, revocations) within 30 days of notification of that final action, in accordance with Chapter 43.21B RCW. The Water Pollution Control Board hears and makes decisions on such appeals.

15. Enforcement

Chapter 173-50 WAC requires that any accredited lab, or lab seeking accreditation, makes its premises available at all times for entry and inspection by Ecology's Lab Accreditation Section for purposes of conducting on-site assessments or otherwise enforcing the regulation. The WAC states further that refusal to permit entry would result in automatic denial or revocation of the lab's accreditation.

Organizations or persons who submit analytical data generated by a lab whose accreditation has not been granted (or has been denied or revoked) are subject to penalty under provision of an Ecology or Washington State Department of Health regulation, permit, contractual agreement, or other regulatory instrument which requires use of an accredited lab.

16. Ecology Assistance to Labs

The Lab Accreditation Section assists all labs participating in Ecology's Laboratory Accreditation Program to the extent resources allow. Although they may be conducted in association with on-site assessments, assistance visits are not assessments, and a corrective action report is not required from the lab in response to deficiencies noted during the visit.

17. Special Requirements for Lab Accreditation Section Staff

Lab Accreditation Section staff acting as assessors of *drinking water* lab capability must attend a Certification Officer training course at NERL Cincinnati. Refresher training is required every five years. Additionally, assessors must maintain proficiency in major technologies for which they assess labs by actually performing analyses within those technologies for two weeks each year. (The training need not be in a continuous one-week period.)

The Section must furnish an annual report to EPA Region 10 covering actions completed regarding drinking water labs in the past year, and actions planned for the coming year.

Selected Section staff acting as drinking water lab assessors would attend an annual meeting of certification officers (assessors) sponsored by EPA.

Section staff will use check sheets when assessing a drinking water lab for the first time, and as often thereafter as dictated by the specific situation regarding the lab.

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18. Guidance for Users of Environmental Data from Accredited Labs

Ecology's Laboratory Accreditation Program requires accredited labs to include quality control (QC) tests as part of their normal sample load. This requirement is not for the benefit of the Lab Accreditation Section which routinely sees the labs' analytical data only once every three years during on-site assessments. Rather, QC tests are intended to give the lab evidence that it is remaining *in control*, and just as importantly, to give data users the basis for determining if a given set of data are reliable. Without such evidence, the data user is assuming that the lab still retains and is using the capability to do good work as determined by the accreditation process.

What types of QC test results should the data user require from labs?

Accredited labs are required to analyze *blanks* in every batch when it is appropriate to do so. (For some tests, there is no such thing as a blank.)

Whenever a *standard* is reasonably available, one should be run in every batch. If a given test is run frequently, the lab should have determined what its *average* result for that standard is (as an absolute value or as a percent recovery), and what the *standard deviation* of repeated results is. The standard deviation is most useful when reported to the data user as a relative standard deviation.

A *duplicate* sample is run on occasion to check within-batch precision. Frequency of the duplicate is greater when there is no readily available standard for checking total precision. Some methods require special QC tests, and data users should become familiar enough with the methods to determine which QC tests are required for which methods.

For certain tests, accredited labs are required to do *method detection limit (MDL)* studies, and the lab's MDL should be available to include in any report.

What types of QC test are *not* required by the Laboratory Accreditation Program?

Lab accreditation does not require labs to run *matrix spikes* or other tests where results depend more on the matrix than they do on the analytical capability of the lab. This is not to suggest that the data user should not require the lab to run such tests and report the results; it is just to acknowledge that such QC test results cannot be expected merely because the lab is accredited.

How should the QC test results be interpreted by the data user?

A valuable source for determining how QC tests results should be used is Ecology Publication 01-03-003, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies,* February 2001 (on the web at http://www.ecy.wa.gov/biblio/0103003.html. In a more general sense, results of the QC tests mentioned above can be interpreted as follows:

Blanks

Blank results indicate the possible presence or absence of contamination in the analytical process. They can also be used as an indication that the entire analytical process has been applied correctly.

Standards

A single result for analysis of a standard in itself does not provide much useful information. It is more meaningful to evaluate the average (mean) of repeated results for the standard, and then compare the result submitted with a given data package to that average. The difference between the average result and the true (or accepted) value is an indication of bias. The standard deviation of repeated results is an indication of total precision. Generally, the published methods (usually in the last or next to last paragraph) give the data user an idea of expected bias and precision.

Duplicates

Results for duplicates give the data user an indication of precision for whatever process is being duplicated. If a sample is split in the lab and each fraction analyzed identically, precision of analysis is being checked. If duplicate samples are taken at the sampling site, in addition to checking analytical precision, the precision of sampling and the degree of homogeneity of the sampling area is being checked.

Matrix Spikes

Matrix spike results are a check of interference due to the matrix. If the results for the standard run in the batch are within acceptance limits, and the matrix spike result is not acceptable, the failing matrix spike result is most likely due to matrix interference. But if the result for the standard is NOT within acceptance limits, the matrix spike result is of little value. Low matrix spike recoveries should prompt the data user to coordinate with the lab for the purpose of improving recovery, perhaps by use of an alternative method.

Method Detection Limit Studies

Knowing the lab's MDL for a given test gives the data user an idea if reliable data can be expected at the concentration of interest for the samples analyzed in the lab.

Appendices

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Appendix A

Glossary

Accuracy	Degree of agreement between an analytical result and the true value. Accuracy is affected by both random error (imprecision) and systematic error (bias), but is sometimes used improperly to denote only systematic error. (See *Bias* and *Precision.)*
Action Limit	A type of control limit on a control chart, which, if exceeded, requires corrective action to be taken. Action limits are usually placed at ±3 standard deviations from the expected or mean value.
Analyte	The species quantified in chemical, but not physical or microbiological determinations.
Analytical Data	The qualitative or quantitative results from a chemical, physical, microbiological, toxicological, radiological, or other scientific determination.
Analytical Method	Written instructions describing an analytical procedure followed to obtain a numerical estimate of the determinand (analyte) in a sample or samples.
Analytical Response	The output of a measurement system in response to a sample (e.g., spectrophotometric measurement of the absorbance of a solution). The magnitude is related to the concentration of the determinand (analyte) in the sample by calibration of the measurement system.
Analytical Result	A numerical estimate of the concentration of a determinand (analyte) in a sample, obtained by carrying out the procedure specified in the analytical method once (unless the method calls for the result to be the average of two or more responses). The result also can be thought of as the final value reported to the user.
Analytical System	A combination of analyst, analytical method, equipment, reagents, standards, laboratory facilities, and other components involved in carrying out an analytical procedure.
Assessor (Auditor)	A person who evaluates laboratories for the purpose of accreditation. The EPA term for this person is auditor.

Bachelor Degree (or equivalent)	A college degree with an equivalent of 30 semester hours in a specific discipline. "Equivalent" is at least four years of experience in a specific scientific discipline.
Batch	A set of samples analyzed together without interruption, sometimes called a "run." Results are usually calculated from the same calibration curve or factor.
Bias	The effect of systematic error on an analytical result. (See *Systematic Errors.)*
Blank	A sample expected to contain none of the analyte or determinand of interest. *Field blanks* are used to obtain information on contamination introduced during sample collection, transport, or storage. *Method blanks* are most commonly used to reveal contamination in the laboratory (as opposed to in the sampling process).
Calibration Standard	Solution of a known analyte concentration, used in the calibration procedure to determine the relationship between concentration and analytical response.
Certification Officer	"Certification Officer" is an EPA term for "Assessor" in Ecology's program, except that Assessors do not make accreditation decisions as Certification Officers do under the EPA guidance document.
Certified Reference Material (CRM)	A substance, one or more property values of which are certified by a technically valid procedure accompanied by or traceable to a certificate or other document issued by a recognized certifying authority.
Check Standard	A solution of known concentration that is used to check for certain sources of bias and the precision of analyses. When used in conjunction with a control chart, it becomes a *control standard*. If the standard goes through the entire analytical process including digestion, it is often called a *laboratory control standard (LCS).* Check standards are prepared from different sources than standards used for calibration.
Control Chart	A graphical representation of the precision of QC test results indicating whether the measurement system is in statistical control. For repeated analyses of standards, the chart is usually based on the average result of those

	analyses (20 results is generally accepted as the minimum to assure valid statistics), and upper and lower control limits based on the standard deviation of the results. (See *Control Limits*.)
Control Limits	Statistical warning and action limits calculated for control charts, used to make decisions on acceptability of control test results. *Warning limits* are usually established at two standard deviations above and below the mean of repeated analyses of a standard. *Action limits* are established at three standard deviations.
Data Quality Indicators (DQIs)	Qualitative statements of data quality addressing *accuracy*, *completeness*, *representativeness*, and *defensibility* as a minimum.
Data Quality Objectives (DQOs)	Quantitative statements of how accurate data must be to serve their intended use for decision making. Such statements address *bias* and *precision*, the two measurable components of accuracy.
Determinand	That which is determined by the analytical process, including chemical, physical, radiological, microbiological, and other environmental tests.
Holding Time	The allowed time from when a sample was taken or extracted until it must be analyzed. For composited samples, the holding time starts when the last composite aliquot is collected.
Initial Demonstration of Capability	Demonstration by a lab or an analyst of ability to meet acceptable precision and bias objectives, and meet desired method detection limits.
Matrix	The substance from which a material to be analyzed is extracted, such as ground or ambient water, wastewater, air, solid, semisolid (such as tissue), or chemical compounds (such as oil).
Method (Analytical Method)	A written set of instructions defining the measurement process, usually published by a widely recognized entity.
On-site Assessment	An on-site inspection of laboratory capabilities, usually by an outside agency

Parameter	A pairing of an analyte, analyte group, or determinand and a specific method used for quantifying or qualifying that analyte/determinand. For example, "pH by EPA Method 150.1" is a parameter, as is "aromatic halocarbons by EPA Method 601."
Percent Relative Standard Deviation (%RSD)	The standard deviation of repeated results of the same sample, divided by the mean of those results, and expressed as a percent.
Performance Assessment	A study in which proficiency testing samples provided by an independent vendor are analyzed by a lab. True values of such samples must be unknown to the lab. Such samples are referred to as "blind" samples, and if the lab does not know it is analyzing such samples, they are referred to as "double blind."
Precision	A measure of the variability (spread) in the results for replicate measurements caused by random error. Also referred to as *imprecision*. Precision is usually measured as *standard deviation, percent relative standard deviation* (%RSD*),* or *relative percent difference* (RPD).
Quality Assurance (QA)	The total integrated program for ensuring reliability of monitoring and measurement data.
Quality Control (QC)	The routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements.
Random Error	Variability in results for multiple analyses of identical portions of a homogeneous sample. Random error is so named because the size and magnitude of the difference between replicate results vary at random and not in any systematic way.
Reference Material	A material or substance usually taken from a natural source (such as a sediment), one or more properties of which are sufficiently well established to be used for the calibration of an apparatus or the assessment of a measurement method. Often called "standard reference materials" (SRM) or "certified reference materials" (CRM).

Relative Percent Difference (RPD)

The difference between duplicate results for analyses of a sample, relative to the mean (average) value of those results, and expressed as a percentage of the mean.

$$\text{RPD} = \frac{100(R_1 - R_2)}{(R_1 + R_2)/2}$$

$$= \frac{200(R_1 - R_2)}{(R_1 + R_2)}$$

where R_1 is the result of the first analysis, and R_2 the second.

Relative Standard Deviation (RSD)

The standard deviation relative to the mean (also called coefficient of variation). It is calculated as either:

$$s / \bar{x} \quad \text{or} \quad 100\, s / \bar{x}$$

Where $\bar{x}$ is the mean result and s is the standard deviation (see *Standard Deviation*). $100s / \bar{x}$ is sometimes referred to as the percent relative standard deviation or %RSD.

Spike

A known amount of analyte added to a sample to reveal bias due to interference present in the sample. The degree of interference is measured as a percent recovery. If the spike is added to a "clean" material (e.g., reagent grade water), the sample may be called a *spiked blank* or a *fortified blank*. If the spike is added to an environmental sample, the sample may be called a *matrix spike*. Analysis of matrix spikes is intended to reveal matrix interference.

Standard

A solution of known and documented concentration, either a check or control standard, or a calibration standard that is used to prepare a calibration curve.

Standard Deviation

A statistic that describes the random variability (spread) of results. An actual standard deviation is denoted by "σ", whereas an estimate of the standard deviation is denoted by "s". For a sample of "n" replicate results taken from a population of sample analytical results, the estimate of the standard deviation is:

$$s = \sqrt{\frac{\sum x_i^2 - \left[\left(\sum x_i\right)^2 / n\right]}{n-1}}$$

$$= \sqrt{\frac{\sum x_i^2 - n\left(\bar{x}\right)^2}{n-1}}$$

$$= \sqrt{\frac{\sum \left(x_i - \bar{x}\right)^2}{n-1}}$$

where x_i is a result and $\bar{x}$ is the mean of "n" results. For analyses of "m" pairs, the estimate of standard deviation, where "d" is the difference between the pairs of results, and "i" is the number of pairs is:

$$s = \sqrt{\left(\sum d_i^2\right) / 2m}$$

Standard Operating Procedure (SOP) — A detailed written description of a procedure designed to systematize performance of the procedure.

Surrogate Standard — A type of spike added to each sample for certain types of analyses (e.g., trace organics), in a known amount, and at the start of the analytical process. A surrogate compound is similar to, but not identical to, one of the target analytes in the sample, and they are not expected to be present in environmental samples.

Systematic Errors — Errors that cause a tendency of results to consistently be greater or smaller than the true value. Usually bias can be considered to be equivalent to systematic error.

Target Compound (or Analyte) — A compound or element expected to be in a sample, or for which the analysis is being conducted.

Warning Limit — A type of control limit that is specified by a value on a control chart, usually ±2 standard deviations distant from the expected or mean value. Action is required when results fall outside the warning limits too frequently. A single value outside a warning limit does not require action, but should alert one to a possible problem. Three consecutive results outside a warning limit should be cause for corrective action.

Appendix B

Summary of Requirements to Use Accredited Laboratories

Requirements for use of accredited labs are found in several documents. The oldest is Ecology Executive Policy 1-22 which requires use of accredited labs for all water matrix analyses other than those submitted in accordance with a wastewater discharge permit.

Executive Policy 1-22

After July 1, 1990, managers responsible for ordering lab services through regulations, permits (other than wastewater discharge permits), or contractual agreements will ensure that water quality analyses are performed by laboratories accredited by Ecology's Quality Assurance Section. Applicable water quality data include results of analyses of sediment, dredging, and sludge; point source and non-point source pollution samples; and surface, marine and ground waters. Applicable analyses include chemical, physical, biological, microbiological, radiological, or other scientific determinations which provide recorded qualitative and/or quantitative results.

Wastewater Discharge Permit Programs

Chapter 173-220-210 WAC (NPDES Permit Program) required use of accredited labs for all major NPDES permittees by July 1, 1992. The same WAC, and WACs 173-216-125 (State Discharge Permit Program) and 173-226-090 require all other permitted dischargers to use accredited labs by July 1, 1994. All monitoring data submitted to Ecology must come from accredited labs, with specific exceptions. Those tests which need not be conducted by an accredited lab are:

- All tests which are done for process control only.
- Flow, temperature, and settleable solids.
- Conductivity and pH[1], if the lab operated by a discharger is not required to be accredited for any other test.

Model Toxics Cleanup Program

Chapter 173-340-830(2)(a) WAC states that "all hazardous substance analyses shall be conducted by a laboratory accredited under Chapter 173-50 WAC, unless otherwise approved by the department." This requirement includes accreditation for the Northwest Total Petroleum Hydrocarbon methods commonly referred to as:

- NWTPH-Gx Gas-range organics
- NWTPH-Dx Diesel-range organics
- NWTPH-EPH Extractable petroleum hydrocarbons
- NWTPH-VPH Volatile petroleum hydrocarbons

[1] At the time this manual was being written, this requirement was being considered for change. Wastewater dischargers should check with their permit managers to determine if a given test has been excluded from the accreditation requirement.

Storm Water Permits

All monitoring data, except for flow, temperature, pH, total residual chlorine, and other exceptions approved by Ecology, must come from an accredited lab.

Puget Sound Estuary Program (PSEP)

In observation of Ecology's Executive Policy 1-22, PSEP advised all labs supporting PSDDA projects, via a June 28, 1991 letter, that they would need to be accredited when using methods in Appendix D of the PSEP Protocols (referred to as PSEP App D), or in SW-846.

DOH Drinking Water Program

The Washington State Department of Health (DOH) requires that laboratories analyzing drinking water be accredited "by the Department." In November 2002, the Washington State Department of Ecology assumed the mission of accrediting drinking water labs; therefore, the DOH requirement is considered to mean that accreditation by the "Department of Ecology" is required.

DOH Clandestine Drug Lab Program

DOH requires that labs analyzing methamphetamine be accredited for the specific compound. There are special requirements that must be met for accreditation. Labs considering applying for methamphetamine accreditation should consult with the Lab Accreditation Section early in the process.

Other Programs

Ecology programs may require use of accredited labs, even though the accreditation may be for methods somewhat different than those used by that program. For example, a program for which soil analyses are required for a given analyte may require use of a lab accredited to analyze for that analyte in a water matrix. Government agencies other than Ecology, and any other lab clients, also are likely to require use of an accredited lab.

Appendix C

Contacts – Ecology and EPA

Ecology Lab Accreditation Section

Lab Accreditation Section
Washington State Department of Ecology
PO Box 488 (or 2350 Colchester Drive)
Manchester, WA 98353-0488

Telephone: (360) 895-6145
Fax: (360) 895-6180
Web Site: http://www.ecy.wa.gov/programs/eap/labs/labs_main.html
E-mail: xxxx461@ecy.wa.gov ("xxxx" = four letters shown below for each name)

Staff	*Special Areas of Interest*	*Phone*
Aimee Bennett (aben)	Microbiology	(360) 895-6179
Perry Brake (pbra)	Overall Management	(360) 895-6149
Margaret Datin (mdat)	Aquatic Toxicology (Bioassays)	(360) 895-6176
Lee Fearon (lfea)	Trace Metals	(360) 895-6146
Dennis Julvezan (djul)	General Chemistry, Computer Support	(360) 895-6147
Bill Kammin (wkam)	ICP/Mass Spec, Database	(360) 895-6177
Stew Lombard (slom)	Quality Control, DMR-QA Coordinator	(360) 895-6149
Alan Rue (arue)	Organics	(360) 895-6178
Connie Schreiber (cosc)	Application/Fees, Accreditation Process	(360) 895-6145

Ecology Cashiering Section

Cashiering Section (360) 407-7095
Washington State Department of Ecology
PO Box 5128 (or 300 Desmond Drive)
Lacey, WA 98503-5128

EPA Region 10 Quality Assurance Section

A. Dan Baker III, QA Specialist (206) 553-1692
U.S. EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101

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Appendix D

Supplemental Information on Drinking Water Lab Accreditation

The Washington State Department of Health has historically certified drinking water (DW) labs for microbiology tests by *determinand,* such as total coliforms and E. coli, and *technology,* such as Chromogenic-Fluorogenic. Ecology's Laboratory Accreditation Program requires accreditation by *determinand* and published *method*, such as Standard Methods 9221B and 9221E1. Under the combined program, microbiology tests will be accredited by *determinand* and *method*.

Because this change could cause confusion for DW labs and users of data from such labs, the following information is furnished to assist in completing applications and interpreting Scopes of Accreditation. All methods are in the APHA *Standard Methods for the Examination of Water and Wastewater,* 20th Edition.

Determinand	Procedure (not on Scope)	Method
Fermentation Techniques for Total Coliforms, Fecal Coliforms, & E. coli		
Total Coliforms & Fecal Coliforms	LTB Multiple Tube & EC Broth	9221 B/9221 E1
	Clark's PA Broth & EC Broth	9221 D/9221 E1
	LTB & EC Broth Serial Dilution	9221 B/9221 C/9221 E1
Total Coliforms & E. coli	LTB Multiple Tube & EC MUG Broth	9221 B/9221 F
	Clark's PA Broth & EC MUG Broth	9221 D/9221 F
	LTB & EC MUG Broth Serial Dilution	9221 B/9221 C/9221 F
Fecal Coliforms	A-1 Media Serial Dilution	9221 E2 & 9221 C
Membrane Filtration Techniques for Total Coliforms, Fecal Coliforms, & E. coli		
Total Coliforms & Fecal Coliforms	mEndo/LES Endo & EC Broth	9222 B[1] & 9221 E1
Total Coliforms & E. coli	mEndo/LES Endo & EC MUG	9222 B[1] & 9221 F
	mEndo/LES Endo & EC MUG (membrane transfer)	9222 B[1] & 9222 G1a
	mEndo/LES Endo & NA MUG (membrane transfer)	9222 B[1] & 9222 G1b
	MI Agar	EPA 1604
	mColiBlue 24	Hach (mColiBlue24)

[1] *P/A Reporting is 9222 B6a ; Density Reporting is 9222 B6b*

Determinand	Procedure (not on Scope)	Method
Membrane Filtration Techniques (Cont'd)		
Fecal Coliforms	MFC	9222 D
Total Coliforms (*Non-potable only)*	mEndo/LES Endo	9222 B6b
E. coli (*Non-potable only)*	mTEC	9213 D & 9222 B.5f2b
Chromogenic-Fluorogenic Techniques for Total Coliforms & E. coli		
Total Coliform & E. coli	Colilert	9223 B[2] (Colilert)
	Colisure	9223 B[2] (Colisure)
	EColite	Hach (EColite)
Heterotrophic Plate Count Methods[3]		
Heterotrophic Bacteria	Pour Plate	9215 B
	Spread Plate	9215 C
	Membrane Filtration	9215 D

[2] *Multiple Tube format is 9223 B2a; Quantitray format is 9223 B2b; Single Volume format is 9223 B2c.*

[3] *Only Pour Plate is acceptable for regulatory drinking water applications.*

Appendix E

Approved Proficiency Testing Sample Providers

Following is a list of authorized providers of proficiency testing (PT) samples. Identification of the commercial suppliers is not intended to be an endorsement of their products or service.

Absolute Standards, Inc.
PO Box 5585
Hamden, CT 06518

Telephone: (800) 368-1131
FAX: (800) 410-2577
Web: http://users.aol.com/absolutest/index.html
E-Mail: AbsoluteSt@aol.com

AccuStandard, Inc.
25 Science Park, Box One
New Haven, CT 06511

Telephone: (800) 442-5290
FAX: (203) 786-5287
Web: http://www.connix.com/~accustnd
E-Mail: usa@accustandard.com

Analytical Products Group
2730 Washington Blvd.
Belpre, OH 45714

Telephone: (800) 272-4442
FAX: (614) 423-5588
Web: http://www.apgqa.com
E-Mail: info@apgqa.com

Analytical Standards, Inc.
6331 Emerson Avenue
PO Box 4060
Parkersburg, WV 26104-4060

Telephone: (800) AUDIT-44
FAX: (304) 422-4761
Web: http://www.asipt.com/
E-Mail: csr@asipt.com

Environmental Resource Associates
5540 Marshall Street
Arvada, CO 80002

Telephone: (800) 372-0122
FAX: (303) 421-0159
Web: http://www.eraqc.com
E-Mail: qcstds@aol.com

Microcheck, Inc.
142 Gould Road
Northfield, VT 05663

Telephone: (877) 934-3284
FAX: (802) 485-6100
Web: http://www.microcheck.com
E-Mail: ColiPT@microcheck.com

NSI Solutions, Inc.
7517 Precision Drive, #101
Raleigh, NC 27617

Telephone: (919) 957-9672
FAX: (919) 957-7562
Web: http://www.nsi-es.com
E-Mail: NSI@nsi-es.com

Protocol Analytical Supplies
3941 Ryan Street
Lake Charles, LA 70605

Telephone: (732) 627-0500
FAX: (732) 627-0979
E-Mail: tstokeld@remelinc.com

Remel, Lake Charles
3941 Ryan Street
Lake Charles, LA 70605

Telephone: (800) 256-4376 x203
FAX: (337) 479-1006
E-Mail: tstokeld@remelinc.com

R. T. Corporation
PO Box 1346
2931 Soldier Springs Road
Laramie, WY 82070

Telephone: (800) 576-5690
FAX: (307) 745-7936
Web: http://www.rt-corp.com
E-Mail: rtcrefmat@aol.com

Spex CertiPrep
203 Norcross Avenue
Metuchen, NJ 08840

Telephone: (800) LAB-SPTX
FAX: (732) 603-9647
Web: http://www.spexcsp.com
E-Mail: CertiPrep@spexcsp.com

Appendix F

Examples of Most Frequently Requested Parameters

The following list of parameters commonly requested by labs applying for accreditation is provided for the convenience of the labs. It is not intended to be a complete list of all parameters for which Ecology accredits, but rather to give the lab an idea of the type of test that may be requested within the various matrix classifications. Some parameters are included in more than one matrix; this is especially true for Non-Potable Water and Drinking Water general chemistry parameters.

An asterisk (*) following the named analyte/determinand indicates that Ecology's Laboratory Accreditation Program does not require submission of proficiency testing (PT) sample results for that analyte/determinand. In some cases, an entire group of analyte/determinands does not require participation of labs in PT studies. For example, labs applying for accreditation of microbiology tests in Non-Potable Water are not required to submit PT results.

Non-Potable Water		
Parameter	Reference	Method
CHEM I (GENERAL CHEM)		
Acidity	EPA	305.1
Alkalinity, Total	SM	2320 B(4c)
Alkalinity, Total	EPA	310.1
Ammonia	EPA	350.3
Anionic Surfactants*	EPA	425.1
Anionic Surfactants*	SM	5540 C
Biochemical Oxygen Demand, BOD/CBOD	EPA	405.1
Chemical Oxygen Demand (COD)	EPA	410.4(7.3)
Chloride	SM	4110 B
Chlorine Residual, Total	EPA	330.1
Chlorine Residual, Total	EPA	330.5
Chlorine Residual, Total	SM	4500-Cl G
Color*	EPA	110.2
Cyanide, Total	EPA	335.2(8.10)
Cyanide, Total	SM	4500-CN E
Fluoride	EPA	340.2
Hardness, Total (as CaCO3)	SM	2340 B
Hexane Extractable Material	EPA	1664
Hardness, Total (as CaCO3)	EPA	200.7
Nitrogen, Total Kjeldahl	EPA	351.3
Nitrate	SM	4500-NO3 E
Nitrate + Nitrite	EPA	353.2
Orthophosphate	EPA	365.2

pH	EPA	150.1
Phenolics, Total Recoverable	EPA	420.1
Phosphorus, Total	EPA	365.2
Solids, Total Dissolved	EPA	160.1
Solids, Total Suspended	EPA	160.2
Solids, Total	EPA	160.3
Solids, Total Volatile*	EPA	160.4
Specific Conductance	EPA	120.1
Sulfate	EPA	300
Sulfide*	EPA	376.1
Sulfide	EPA	376.2
Sulfite*	EPA	377.1
Total Organic Carbon	EPA	415.1
Total Organic Halides	SM	5320
Turbidity	EPA	180.1
Turbidity	SM	2130 B
CHEM II (TRACE METALS)		
Copper	EPA	200.8
Lead	EPA	200.7
Lead	SM	3111 B
Mercury	EPA	245.1
ORGANICS I (GC)		
Chlorinated Herbicides	EPA	615
Organochlorine Pesticides	EPA	608
Polychlorinated Biphenyls	EPA	608
Polycyclic Aromatic HC (PAH)	EPA	610
Purgeable Aromatics	EPA	602
Purgeable Halocarbons	EPA	601
Total Pet Hydrocarbons - Gasoline	WDOE	WTPH-G
Total Pet Hydrocarbons - Diesel	WDOE	WTPH-D
ORGANICS II (GC-MS)		
2,3,7,8 - TCDD	EPA	613
BNA Extr (Semivolatile) Organics	EPA	625
PCDDs/PCDFs	EPA	1613
Purgeable (Volatile) Organics	EPA	624
RADIOACTIVITY		
Alpha Total (Gross)	EPA	900
Beta Total (Gross)	EPA	900
Cesium-134/Cesium-137	EPA	901
Radium-223/224/226	EPA	903
Radium-226	EPA	903.1
Radium-228	EPA	904
MICROBIOLOGY		
E. coli*	SM	9213 D
Fecal Coliforms*	SM	9222 D

Fecal Coliforms*	SM	9221 E
Total Coliforms*	SM	9222 B
Total Coliforms*	SM	9221 B
BIOASSAY (Toxicity)*		
Algal Freshwater Growth	EPA	1003
Algal Marine Repro	EPA	1009
Algal Growth	SM	8112
Amphipod, Sediment	Nebek	1984
Amphipod	EPA	600/4-90/027F
Amphipod	ASTM	1994
Amphipod Hyalella, Sediment	Nebek	1988
Amphipod Rhepoxinius, Sediment	PSEP	1995
Bivalve Larvae	SM	8610
Bivalve Larvae	ASTM	E724-94
Bivalve Larvae, Sediment	PSEP	1995
Bivalve Larvae	EPA/C	1977
Bivalve Larvae, West Coast Species	EPA	1005
Chromosomal Abnormality, Sediment	PSEP	1995
Daphnid	EPA	600/4-90/027
Daphnid Survival Repro	EPA	1002
Daphnid	SM	8711
Daphnid	ASTM	E729-80
Echinoderm	EPA	1008
Echinoderm	Dinne	1987
Echinoderm, West Coast Species	EPA	1008
Echinoderm, Sediment	PSEP	1995
Fathead Minnow Larval Surv Growth	EPA	1000
Fathead Minnow Emb-Larv Surv Terato	EPA	1001
Salmonid	WDOE	80-12 Part A
Fish	EPA	600/4-90/027F
Fish	SM	8910
Inland Silverside Larval Surv Growth	EPA	1006
Microtox	Micro	Microbics
Microtox, Sediment	PSEP	1995
Microtox, Sediment	Tung	1990
Mutagenicity	EPA	600/4-82-068
Mutagenicity	Maron	1983
Mysid	EPA	600/4-90/027F
Mysid Marine Survival Growth Fecund	EPA	1007
Mysids, West Coast Species	EPA	1007
Polychaetes	SM	8510
Polychaetes/Neanthes, Sediment	EPA	910/9-90/011
Polychaetes/Neanthes, Sediment	PSEP	1995
Rat	WDOE	80-12 Part B
Sheepshead Minnow Larval Surv Growth	EPA	1004
Topsmelt, West Coast Species	EPA	1006

IMMUNOASSAY		
PHYSICAL		
Drinking Water		
Parameter	Reference	Method
CHEM I (GENERAL CHEM)		
Alkalinity, Total	SM	2320 B
Bromide	EPA	300
Chlorine Residual, Total	SM	4500-Cl G
Chloride	EPA	300
Chlorite	EPA	300
Color*	SM	2120 B
Cyanide, Total	EPA	335.4
Cyanide, Total	SM	4500-CN E
Fluoride	SM	4500-F C
Hardness, Total (as CaCO3)	SM	2340 B
Nitrate	EPA	300
Nitrate	EPA	335.2
Nitrite	EPA	335.2
Nitrate-Nitrite	EPA	335.2
Orthophosphate	SM	4500-P E
pH	EPA	150.1
Specific Conductance	SM	2510 B
Solids, Total Dissolved	EPA	160.1
Solids, Total Dissolved	SM	2540 C
Sulfate	EPA	300
Total Organic Carbon	SM	5310 B
Turbidity	EPA	180.1
CHEM II (TRACE METALS)		
Copper	EPA	200.7
Lead	EPA	200.8
Mercury	EPA	245.1
ORGANICS I (GC)		
Carbamates	EPA	531.1
Chlorinated Acids	EPA	515.1
Haloacetic Acids	EPA	552.2
Pesticides	EPA	505
ORGANICS II (GC-MS)		
BNA's	EPA	525.2
Pesticides	EPA	525.2
Regulated VOCs	EPA	524.2
Trihalomethanes	EPA	524.2
Unregulated VOCs	EPA	524.2
MICROBIOLOGY		
Heterotrophic Plate Count	SM	9215 B
Total Coliforms	SM	9221 B
Coliforms/E. coli Density (MPN)	SM 18	9221 C
Fecal Coliforms (EC Broth)	SM 18	9221 E(1)
Fecal Coliforms (A-1)	SM 18	9221 E(2)
E. coli (EC MUG)	SM 20	9221 F
Total Coliforms (Endo type)	SM 18	9222 B(6a)

Total Coliforms (Endo type)	SM 18	9222 B(6b)
Fecal Coliforms (m-FC)	SM 18	9222 D
Total Coliforms/E. coli (Colisure)	SM 20	9223 B(2)
Total Coliforms/E. coli (Colilert)	SM 20	9223 B(2)
Solids and Chemical Materials		
Parameter	Reference	Method
CHEM I (GENERAL CHEM)		
Bromide	EPA	9056
Chloride	EPA	9056
Cyanide	EPA	9012
Fluoride	EPA	9056
Nitrite	EPA	9056
Nitrate	EPA	9056
pH*	EPA	9040
pH*	EPA	9045
Phenolics, Total Recoverable	EPA	9065
Sulfate	EPA	9038
Sulfate	EPA	9056
Total Organic Carbon	EPA	9060
Total Organic Halides	EPA	9020
CHEM II (TRACE METALS)		
Chromium	EPA	6020
Lead	EPA	6010
Mercury	EPA	7470
Mercury	EPA	7471
ORGANICS I (GC)		
BTEX	EPA	8021
Chlorinated Herbicides	EPA	8151
Organochlorine Pesticides	EPA	8081
Polynuclear Aromatic Hydrocarbons	EPA	8310
Polychlorinated Biphenyls	EPA	8082
Petroleum Hydrocarbons, Extractable	WDOE	EPH
Petroleum Hydrocarbons, Volatile	WDOE	VPH
Total Pet Hydrocarbons - Diesel	WDOE	NWTPH-Dx
Total Pet Hydrocarbons - Gasoline	WDOE	NWTPH-Gx
Volatile Organic Compounds	EPA	8021
ORGANICS II (GC-MS)		
BNA Extr (Semivolatile) Organics	EPA	8270
PCDDs/PCDFs	EPA	8280
PCDDs/PCDFs	EPA	8290
Volatile Organic Compounds	EPA	8260
RADIOACTIVITY		
Alpha Total (Gross)	EPA	9310
Beta Total (Gross)	EPA	9310
Radium Total	EPA	9315
Radium Total	EPA	9320
Radium-226	EPA	9315
Radium-228	EPA	9320
MICROBIOLOGY		
Total Coliform*	EPA	9131

IMMUNOASSAY		
PCB's	EPA	4020
Petroleum Hydrocarbons	EPA	4030
PAH's	EPA	4035
PHYSICAL		
Corrosivity*	EPA	1110
Ignitability*	EPA	1010
Air and Emissions		
Parameter	Reference	Method
CHEM I (GENERAL CHEM)		
Ammonia	EPA	IO-4.2
Formaldehyde	EPA	8520
pH	EPA	IO-4.1
CHEM II (TRACE METALS)		
Cadmium	EPA	IO-3.4
Lead	EPA	IO-3.5
Mercury	EPA	IO-5
ORGANICS I (GC)		
Formaldehyde	EPA	TO-11A
VOC's	EPA	TO-3
ORGANICS II (GC-MS)		
PAH's	EPA	TO-13A
PCDD's/PCDF's	EPA	TO-9A
VOC's	EPA	TO-1
VOC's	EPA	TO-15